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DEPARTMENT OF COMMERCE AND LABOR
COAST AND GEODETIC SURVEY

O. H. TITTMANN

SUPERINTENDENT

ALASKA

COAST PILOT NOTES ON BERING SEA AND ARCTIC OCEAN

(Replaces Bulletin No. 40)

NOVEMBER 20, 1908



WASHINGTON
GOVERNMENT PRINTING OFFICE

1909

DEPARTMENT OF COMMERCE AND LABOR

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DEPARTMENT OF COMMERCE AND LABOR,

COAST AND GEODETIC SURVEY,

WASHINGTON, D. C., *November 20, 1908.*

The information contained in this publication relates to the Sannak Islands, Fox Islands Passes, Unalaska Bay, the coast and islands of Bering Sea eastward and northward of Fox Islands Passes, and the Arctic Ocean as far as Point Barrow, and replaces Bulletin No. 40.

This publication has been compiled from reports from vessels of the Coast and Geodetic Survey, United States Navy, United States Revenue Cutter Service, and United States Fish Commission, from Mr. S. Applegate, and from all other available sources. To these must be added the information supplied by Lieut. D. H. Jarvis, U. S. R. C. S., who was detailed by the United States Revenue Cutter Service for this duty, and revised the first and second editions of Bulletin No. 40.

The first edition of Bulletin No. 40 was issued May 4, 1899. In this publication the available information to date has been added. It has been prepared by Mr. Herbert C. Graves under the direction of J. J. Gilbert, Assistant, Coast and Geodetic Survey, Inspector of Hydrography and Topography.

As absolute accuracy in a work of this class is scarcely possible, navigators will confer a favor by notifying the Superintendent of the Coast and Geodetic Survey of errors which they may discover, or of additional matter which they think should be inserted for the information of mariners.

O. H. TITTMANN,

Superintendent.

NOTE.

The courses and bearings given in degrees are *true*, reading clockwise from 0° at north to 360° , and are followed by the equivalent *magnetic* value in points in parentheses.

Distances and velocities of currents are in *nautical miles*.

ALASKA.

COAST PILOT NOTES ON BERING SEA AND ARCTIC OCEAN.

TIDES.

Tide tables for the Pacific Coast of the United States, including British Columbia and Alaska, are published annually by the Coast and Geodetic Survey, predicting the times and heights of tides for every day in the year.

On the coast of Alaska, including Bering Sea and the Arctic Ocean, there are usually two unequal high waters and two unequal low waters during the lunar day, the irregularity varying principally with the declination of the moon. When the moon is near the equator the tides are generally nearly equal and have the least diurnal range. When the moon is near its greatest declination (farthest north or south) the tides are very unequal, and are called *tropic tides*. At such times the difference between the higher high and lower low water is the *great tropic range*, which is usually the greatest range for the month.

In Norton Sound the tides are chiefly diurnal, from the fact that the inequality in the tides when the moon is near its greatest declination is increased to such an extent that the minor tides of the day (lower high water and higher low water) disappear, and but one high water and one low water occur during the lunar day. When the moon is near the equator, however, there are generally two high waters and two low waters, more or less unequal, during the lunar day, but the range of the tides is comparatively small.

VARIATION OF THE COMPASS.

The magnetic variations for 1910 and annual decrease at points mentioned are as follows:

LOCALITY.	Variation. E.	Annual decrease.	LOCALITY.	Variation. E.	Annual decrease.
	°	'		°	'
Cape Pankof.....	18 $\frac{2}{3}$	3	Cape Nome.....	20 $\frac{1}{4}$	5
Unimak Pass.....	17 $\frac{2}{3}$	3	Sledge Island.....	19 $\frac{3}{4}$	5
Unalaska Bay.....	17	3	Point Spencer.....	19 $\frac{3}{4}$	5
Amukta Pass.....	14	3	King Island.....	19	6
St. George Island.....	*16	3	Diomed Islands.....	19	6
St. Paul Island.....	*16	3	East Cape.....	18 $\frac{3}{4}$	6
Port Moller.....	20	4	West of Cape Prince of Wales (5 miles).....	19 $\frac{1}{4}$	6
Cape Constantine.....	21 $\frac{1}{4}$	4	Cape Espenberg.....	22 $\frac{1}{2}$	6
Cape Newenham.....	20	4	Chamisso Island, Kotzebue Sound.....	23 $\frac{1}{3}$	6
West of Nunivak Island (15 miles).....	17 $\frac{1}{2}$	4	Cape Blossom.....	23 $\frac{1}{3}$	6
Cape Upright, St. Matthew Island.....	15 $\frac{1}{2}$	4	Point Hope.....	22	7
Cape Chibukak, St. Lawrence Island.....	16 $\frac{1}{2}$	5	Cape Lisburne.....	23	7
East of St. Lawrence Island (35 miles).....	18 $\frac{1}{3}$	5	Point Lay.....	26	8
Cape Romanzof.....	18 $\frac{3}{4}$	5	Icy Cape.....	27	8
St. Michael.....	21 $\frac{1}{2}$	5	Point Belcher.....	28 $\frac{3}{4}$	9
Unalaklik.....	22 $\frac{1}{2}$	5	Point Franklin.....	29 $\frac{1}{4}$	9
Cape Darby.....	21 $\frac{1}{2}$	5	Point Barrow.....	31 $\frac{1}{2}$	10

* Localities of local disturbance.

SANNAK ISLANDS

are the southwestern islands of the groups off the southern side of the Alaska Peninsula. They consist of two large islands, Sannak and Caton islands, and a great number of small islands and rocks southward of the former, $20\frac{1}{2}$ miles long and $10\frac{1}{2}$ miles wide, and all bare of trees. **Sannak Mountain**, at the northwest end of Sannak Island, is the prominent object seen in approaching the group, and is about 3 miles long and 1 mile wide. It is a central peak (Sannak Peak), 1,700 feet high, in latitude $54^{\circ} 28' N.$, longitude $162^{\circ} 45' W.$, with a shoulder on its east side about 1,300 feet high and one on its west side about 700 feet high. At $4\frac{1}{2}$ miles eastward from Sannak Peak this ridge again rises to over 200 feet, but all the remainder of the group is but little over 100 feet high on the northern side, decreasing to less than 40 feet high among the islands and rocks forming the south side.

From time to time sunken rocks and breakers have been reported in numerous localities northward and northwestward of Sannak Islands; no definite information can be given about them, but their reported positions are shown on Coast and Geodetic Survey Chart 8860. Crowley Rock is the only known danger. The eastern end of **Caton Island**, the eastern end of the group, is fringed with reefs and breakers to a distance of over 1 mile. With perhaps the exception of Peterson Bay, the entire south side of Sannak Islands is dangerous for a stranger to approach, especially the southwest end. The principal outlying known dangers are:

Crowley Rock, lying $1\frac{1}{2}$ miles off the north side of Sannak Island and 348° true ($NNW. \frac{3}{4} W.$ mag.) from Sannak Peak, is several small pinnacles very close together. The least depth found was about 12 feet, though there may be less, and there are depths of 9 to 15 fathoms close-to.

The western end of Sannak Island is fringed with rocks. The westernmost known break lies 1 mile 267° true ($WSW. \frac{1}{8} W.$ mag.) from the northwesternmost bare rocks of the group, and nearly 2 miles 281° true ($W. \frac{5}{8} S.$ mag.) from the west point at the entrance to Acherk Harbor.

A reef, with five rocks which show above water, lies between 4 and 5 miles southwestward of Clifford Island. What is supposed to be **Hennig Rock** is the northernmost rock of the reef, and is nearly on the range of Sannak Peak and the western end of **Troitz Island**, the middle and largest Trinity Island, bearing 71° true ($NE. \frac{5}{8} E.$ mag.), distant $3\frac{1}{2}$ miles from the island. **Oneida Rock**, 4 miles 162° true ($SE. \frac{5}{8} S.$ mag.) from Hennig Rock, is the southernmost rock of the reef. It lies 5 miles from Clifford Island, and 224° true ($SSW. \frac{1}{4} W.$ mag.) from Sannak Peak.

A narrow bank about 5 miles long in a 120° true ($E.$ by $S.$ mag.) direction is reported to lie 7 miles southwestward of Clifford Island. Depths of 2 to 7 fathoms were found on it, and it is marked by kelp at slack water. The least depth was found at its northwest end which lies 12 miles 238° true ($SW. \frac{1}{2} S.$ mag.) from Sannak Peak.

Aleks Rock is in latitude $54^{\circ} 20' N.$, longitude $163^{\circ} 10' W.$, and lies $16\frac{3}{4}$ miles 241° true ($SW. \frac{1}{4} S.$ mag.) from Sannak Peak. It is the farthest outlying known rock southwestward of Sannak Island. The least depth found was 9 fathoms, but it is reported to break with an ordinary swell.

Anderson and Lenard Rocks are reported dangers, lying about 25 or 30 miles southward of Sannak Islands. The existence and position of these rocks are doubtful; they may be one and the same rock, though reported in different localities. The original report (1882) placed Anderson Rock in latitude $53^{\circ} 56' N.$, longitude $162^{\circ} 45' W.$ (same as Sannak Peak), and in 1893 a rock just bare at low water was reported in (approximately) latitude $54^{\circ} 03' N.$, longitude $162^{\circ} 45' W.$ Vessels of the United States Government have frequently cruised and sounded over the charted localities of Anderson and Lenard rocks without finding any indication of danger.

Assistant Ferdinand Westdahl, commanding the Coast and Geodetic Survey steamer *McArthur*, searched for these rocks in 1901 but did not find them. He states: "From conversations with the native otter hunter on board, and others on shore, both white men and natives, I am convinced that a rocky shoal lies somewhere near the reported position of the

Lenard Rock (latitude 54° N., longitude $163^{\circ} 13'$ W., approximately); that there is only one such shoal; and that it breaks in heavy weather only, during northeast or southwest swell. It will, until it is found, remain a menace to the free navigation of the vicinity. Some careful navigators, known to me as reliable men, have informed me that they have seen the breakers at a distance in a heavy swell, and I believe them."

ANCHORAGES.

The anchorages at Sannak Islands are suitable for small or moderate-sized vessels only, and with the exception of Caton Harbor there are no harbors affording shelter from all winds.

Acherk Harbor, at the northwest end of Sannak Island, is $\frac{3}{4}$ mile long and about $\frac{1}{4}$ mile wide, and affords a contracted anchorage for small vessels with protection from southerly and westerly winds, but is exposed to winds from northwest to east, and a swell makes in with strong westerly winds. There is a small settlement at the southeast corner of the harbor, at which there is a boat landing, and water can be obtained by boats. The mean rise and fall of the tide is 5.1 feet.

Approaching Acherk Harbor from northward and eastward there are several reported dangers, the positions of which are shown on Coast and Geodetic Survey Chart 8860, but the only known danger is Crowley Rock; the safest way to avoid this rock in coming from eastward is to keep within $\frac{3}{4}$ mile of the north shore of Sannak Island from abreast Northeast Point. *Approaching from northwestward* steer for the western hill or shoulder (about 700 feet) of Sannak Mountain on any bearing between 140° true (SE. by E. $\frac{1}{4}$ E. mag.) and 176° true (SSE. mag.); the former bearing leads about $\frac{3}{4}$ mile northward of the northernmost bare rocks off the western end of Sannak Island, and the latter bearing leads about $\frac{3}{4}$ mile westward of Crowley Rock. When off the entrance, steer 193° true (S. $\frac{1}{2}$ E. mag.) for the middle of the entrance. Keep in mid-harbor until the peaks of Sannak Mountain are in line and the row of houses on the east are directly under them, and anchor in 5 to 6 fathoms, sandy bottom. There are sunken rocks off the points at the entrance, but they are marked by kelp and can be readily avoided.

Murphys Crack is a small indentation about $1\frac{1}{4}$ miles east of Acherk Harbor. It is protected by a reef and affords shelter for the boats of the fishermen who live here.

Pavlof Harbor is a small bay about 1 mile east of the eastern base of Sannak Mountain. It is reported to be a good harbor for small craft, but requires local knowledge because of the protecting reefs at the entrance, and vessels drawing more than 7 or 8 feet can not use it. There is a fishing station here, and the only store on the island where supplies can be obtained.

Unimak Cove, $1\frac{1}{4}$ miles east of Pavlof Harbor, is an open bight, and unimportant.

Johnsons Bay, $1\frac{1}{2}$ miles west of Northeast Point, has an inner harbor for boats and small craft, where there is a fishing station, and vessels may anchor just inside the entrance to the bay, favoring the east side, in about 9 fathoms, with protection from southerly and westerly winds. There are some rocks close to the west point at the entrance.

Northeast Harbor, at the northeast end of Sannak Island, affords anchorage with shelter from northwest and southwest winds, but is exposed to easterly winds. **Northeast Point**, forming the north side of the harbor, is about 100 feet high. **Eagle Rock**, about 50 feet high, lies near the middle of the harbor; it is surrounded close-to by a ledge which covers, and a sunken reef connects it with the head of the harbor. Water can be obtained by boats at the head of the harbor.

To enter give Northeast Point a berth of about $\frac{1}{4}$ mile, and anchor between the point and Eagle Rock, slightly favoring the rock, with Chernabura Island just open of Northeast Point, in 6 to 9 fathoms, sandy bottom.

Lida Anchorage is a temporary anchorage in southerly winds, at the west end of Caton Island, south of Lida Island, and which may be entered on either side of the latter.

Approaching from eastward stand in near the visible rocks off the east end of Lida Island, taking care to avoid the partially covered reef, nearly $\frac{1}{2}$ mile eastward of Lida Island, which extends in a northerly direction from Caton Island. Anchor about $\frac{1}{4}$ mile from Caton Island,

and $\frac{1}{4}$ to $\frac{1}{2}$ mile southward of Lida Island, in 6 to 7 fathoms, sandy bottom; care should be taken not to approach the south side of the anchorage.

Approaching from westward steer for the southwestern side of Caton Island on a 144° true (**SE. $\frac{7}{8}$ E. mag.**) course, passing about $\frac{3}{8}$ mile southward of Lida Island, and leaving a rock awash, lying $\frac{1}{2}$ mile northward from Wanda Island, about $\frac{3}{8}$ mile on the starboard hand, and anchor as directed above. The western end of Lida Island should not be approached closer than $\frac{1}{2}$ mile.

Caton Harbor is a large area with general depths of 2 to 3 fathoms, sandy bottom, on the southwest side of Caton Island, protected on the south by Elma Island and on the northwest by the islands and reefs, above water in many places, between Caton Island and Sannak Island. It is protected from all swells, and schooners of considerable size have wintered here. The entrance is narrow and is close to the west end of Caton Island; there is another entrance, crooked and very narrow, between Elma Island and the southeast end of Sannak Island, but its approach from southward is full of rocks and reefs, and it should not be used except with local knowledge.

To enter Caton Harbor from northward proceed as directed for entering Lida Anchorage from westward, and when well past the rock awash, mentioned under Lida Anchorage, bring the south side of the rock awash in range with Northeast Point astern, and stand in, keeping the range astern, course 125° true (**ESE. $\frac{1}{2}$ E. mag.**), until close to Caton Island. Then keep the bare rocks and kelp projecting from Caton Island close aboard on the port hand, but do not approach the kelp on the starboard hand; the least depth found in the narrowest part of the passage was $4\frac{1}{2}$ fathoms, shoaling inside to $3\frac{1}{2}$ and 3 fathoms. When past the rocks on the port hand steer about 193° true (**S. $\frac{1}{2}$ E. mag.**) about $\frac{1}{2}$ mile, and anchor in about 3 fathoms with **Princess Rock** (high, grassy on top, extensive surrounding reefs covered at high water) in line with Sannak Mountain, bearing 294° true (**W. $\frac{1}{2}$ N. mag.**) This anchorage is about $\frac{1}{2}$ mile from Caton Island, and the same distance from the nearest reef on the western side. Anchorage, with probably better shelter from northeast gales, can be made off the sand beach on Caton Island, just inside the narrow entrance.

Peterson Bay, on the south side of Sannak Island, is well protected from all but southeast winds, especially for small vessels, of 12 feet or less draft, which can anchor well inside the bay abreast the village which is on the north side. The people living here say that in heavy northeast winter gales a heavy swell makes into the bay. The bay is over $1\frac{1}{2}$ miles long 300° true (**W. by N. mag.**), nearly $\frac{1}{2}$ mile wide at the entrance and $\frac{3}{4}$ mile wide at the head, with about 5 fathoms at the entrance and shoaling gradually toward the head, where there is 12 to 14 feet in the widest part of the bay. There is a spot with 11 feet over it 350 yards off the south side and 344° true (**NW. by N. mag.**) from the south point at the entrance. The mean rise and fall of the tide is 4.4 feet.

To enter, in approaching from eastward give the east and southeast sides of Caton Island a berth of about 2 miles to clear the reefs and breakers which extend more than 1 mile off shore, and steer 262° true (**SW. by W. $\frac{5}{8}$ W. mag.**) passing 1 mile southward of Umla Island and Telemitz Island. When the latter island is abeam bring the tangent of the north side of Peterson Bay in line with the slight saddle between Sannak Peak and the eastern shoulder of Sannak Mountain, and run in on this range, course 318° true (**NW. by W. $\frac{3}{8}$ W. mag.**). When the south point of the bay is about $\frac{3}{4}$ mile distant, haul northward a little so as to bring the north side of the bay in line with the extreme southwest tangent of Sannak Mountain, and run in on this range, course 311° true (**WNW. mag.**), until the south point at the entrance bears 187° true (**S. by E. mag.**). Then steer 294° true (**W. $\frac{1}{2}$ N. mag.**) for the middle of the bay and select anchorage according to draft.

IKATAN BAY AND ISANOTSKI STRAIT

separate Unimak Island from the Alaska Peninsula, and have been used by light-draft craft, intended for service on the Yukon River, in making the passage from Puget Sound ports to St. Michael. But the strait is subject to very strong tidal currents, and the northern entrance is shoal and requires local knowledge. Northerly winds draw through the strait with great force.



CAPE PANKOF, UNIMAK ISLAND—FROM EASTWARD.

Ikatan Bay, on the north side of Ikatan Peninsula, is about $3\frac{3}{4}$ miles wide and 5 miles long in a southwest direction, and is free from surf except with winds from north to east. **Sankin Island** lying 1 mile from the north side of the bay, is high, with a rounded, grassy summit; a reef extends from the island toward the nearest point of the peninsula. It is reported that there is no safe passage for vessels northward of the island, and that Sankin Bay, northwestward of Sankin Island, is shoal. The southwest end of Ikatan Bay is separated from Otter Cove by an isthmus, 20 to 30 feet high; a river enters Ikatan Bay at the middle of this low land, and a submerged spit, which drops off abruptly to over 20 fathoms, makes off from its mouth.

In approaching Ikatan Bay from southwestward the only known danger is **Pankof Breaker**, lying a little over 2 miles 53° true (*NE. by N. mag.*) from the southeast point at the entrance to East Anchor Cove. To avoid the rock, round Cape Pankof at a distance of 1 mile and steer 325° true (*NW. $\frac{3}{4}$ W. mag.*) following the northeastern coast of Ikatan Peninsula at a distance of 1 mile.

There is a good anchorage in the bight on the west side of **Ikatan Point**, the south point at the entrance to the bay, in about 9 fathoms, sand and mud bottom, with protection from winds from southeast to southwest; water can be conveniently obtained here. The best anchorage in Ikatan Bay from all southerly winds is on its south side off the low divide leading to Dora Harbor, and 174° true (*SSE. $\frac{1}{8}$ E. mag.*) from Sankin Island. In approaching this anchorage bring Bird Island in sight over the middle of the low land, and anchor in any depth desired, as it shoals gradually to the beach. Anchorage can also be made on the north side of the bay, $2\frac{1}{4}$ miles westward of Sankin Island, in 10 fathoms, sandy bottom, sheltered from ordinary northerly winds, but badly exposed to easterly and southerly winds.

Isanotski Strait has its southerly entrance at the northwest end of Ikatan Bay. This entrance is narrow, and a reef projects from the east point at the entrance, and another from the next point on the west side inside the entrance, and the swirls around them show plainly. In the southern and narrow part of the strait a mid-channel course should be followed.

There is an extensive shoal, or flat, in the northern and widest portion of the strait, lying eastward of the channel and southward of the outlet into Bering Sea. The channel westward of the shoal is said to have a depth of about 2 fathoms. The northern entrance is obstructed by shoals, probably of a shifting nature, and can be used only by light-draft vessels with local knowledge.

Traders Cove, on the eastern side of Isanotski Strait about 7 miles above its entrance from Ikatan Bay, is a good anchorage. **Morzhovoi**, a mission and native village, is on the south side. Fresh water can be obtained at the southeast corner of the cove near the village. The anchorage is in the middle of the cove off the village, with the Greek church bearing about 111° true (*E. $\frac{1}{4}$ S. mag.*), in $4\frac{1}{2}$ fathoms, muddy bottom. Strong winds and williwaws blow across the cove, but the anchorage is good.

Tides.—The mean rise and fall in Ikatan Bay is 4.5 feet.

In the narrow southern part of Isanotski Strait the tidal currents have a velocity of 7 to 9 miles or more, and it is said that there is practically no slack and that the current turns about three hours after high or low water in Ikatan Bay.

IKATAN PENINSULA,

the southeastern extremity of Unimak Island, is about 13 miles long, and is divided into three mountain masses and from Unimak Island by low depressions which extend from West Anchor Cove to East Anchor Cove, and from Dora Harbor and Otter Cove to Ikatan Bay.

Cape Pankof (see view), the eastern end of Ikatan Peninsula, terminates in three cliffs on the southern side, the highest about 1,200 feet, but on the northern side there is a gentle slope to the low isthmus between East and West Anchor coves. Some bare rocks lie within $\frac{1}{4}$ mile from the cape.

Pankof Breaker lies a little over 2 miles 53° true (*NE. by N. mag.*) from the southeast point at the entrance to East Anchor Cove. It is a pinnacle rock, judging from the appearance of the break, with probably less than 10 feet over it and 13 to 25 fathoms close to.

A rock, said to have about 4 fathoms over it and to break in a southwest swell, is reported to lie about 2 miles 120° true (*E. by S. mag.*) from Cape Pankof.

Bird Island, about $\frac{1}{2}$ mile in extent, 750 feet high, and precipitous, lies 2 miles from the south coast of Ikatan Peninsula, off the entrance to Dora Harbor, and 8 miles westward from Cape Pankof. A sunken reef connects the island with the western point at the entrance to Dora Harbor, and there is no safe passage for vessels between. The western end of the island should not be approached closer than $\frac{1}{2}$ mile.

East Anchor Cove, on the north side of Cape Pankof, is a good anchorage except with winds from north to southeast. The cove is large and easily entered, and the only known danger in the approach is Pankof Breaker. *To enter* give the southeast point at the entrance a berth of over $\frac{1}{2}$ mile, and select anchorage as desired in 7 to 10 fathoms. The cove is free from dangers if the shore be given a berth of about $\frac{1}{4}$ mile.

West Anchor Cove, on the southern side of Ikatan Peninsula, about midway between Cape Pankof and Bird Island, affords anchorage with shelter from northerly winds and probably from easterly winds, but there is always more or less surf in the cove, and it should be regarded as a temporary anchorage only until it is better known. No sounding has been done in the cove. The *McArthur* anchored for one night in the bight on the northern side, 1 mile inside the western point at the entrance, in 13 fathoms, sandy bottom. The survey shows a number of rocks off the southeast point at the entrance, and one large rock about $\frac{1}{4}$ mile from shore. A reef, said to be partly bare at extreme low water and with a rock about 15 feet high near its end, is reported to extend $1\frac{1}{8}$ miles southwestward from the southeast point at the entrance. The same report states that a reef makes out about $\frac{1}{4}$ mile from the middle of the north shore of the cove. It is reported that the eastern end of the cove has ledges, bare at low water, and rocky bottom.

Dora Harbor, on the south side of Ikatan Peninsula, 2 miles north of Bird Island, affords good anchorage with protection from all winds and swell, especially for vessels of about 9 feet or less draft, which can anchor near the head. The entire shore of the harbor is fringed by ledges, partly bare at low water, to a distance of about 300 yards. The reef extending $\frac{1}{4}$ mile westward from the eastern point of the entrance, and that projecting from the western point toward Bird Island afford protection from ordinary southerly and westerly swell at the outer anchorage, but a heavy swell from southward is uncomfortable. The inner harbor is a slight expansion at the head with depths of 10 to 12 feet in the middle; there is a fishing station and stream on its west side.

To enter Dora Harbor, steer for the west point at the entrance on a 334° true (*NW. mag.*) course, passing $\frac{3}{4}$ mile northeastward of Bird Island. When the north end of Bird Island bears on the port beam steer 350° true (*NNW. $\frac{1}{2}$ W. mag.*). Keep in mid-harbor and anchor with the east point at the entrance bearing 154° true (*SE. mag.*) and the west point 249° true (*SW. $\frac{1}{2}$ W. mag.*) in about 5 fathoms. This anchorage is about midway between the east point at the entrance and a projecting point on the west side halfway up the harbor, and the clear width of the anchorage is $\frac{1}{4}$ mile. Vessels of 9 feet or less draft may follow a mid-harbor course and anchor in the middle of the inner harbor, off the fishing station, in 12 feet of water.

Otter Cove is an open bight at the northwest end of Ikatan Peninsula. It is exposed to southerly winds and to the Pacific swell, and there is always a heavy surf. Northerly winds blow with great violence over the low isthmus separating it from Ikatan Bay. The only safe boat landing is in its eastern corner. **A rock awash** at low water lies over $\frac{1}{2}$ mile from the shore of Ikatan Peninsula and $3\frac{1}{2}$ miles northwestward from Bird Island.

SOUTH COAST OF UNIMAK ISLAND FROM OTTER COVE TO CAPE SARICHEF.

This coast, having a length of about 70 miles, has cliffs in places, with lower land and sand beaches between, and is backed by the high mountain masses of the central part of the island. The coast is fairly regular, with no indentations of any extent, and there are no harbors nor sheltered anchorages. The coast is exposed to the ocean swell, and there is generally a heavy surf, which makes landing dangerous. From the few soundings made, the 10-fathom



PROMONTORY HILL, UNIMAK ISLAND—FROM EASTWARD.



PINNACLE ROCK, SCOTCH CAP, NW. $\frac{1}{2}$ W.

curve is less than $\frac{3}{4}$ mile from the beach in most places, and there are no known outlying dangers.

Cape Lazaref is the southwesternmost of three high cliffs, with sand beaches between, which are found in a distance of about 8 miles southwestward of Otter Cove, and is 1,000 feet high. From the sharp point of the cape a reef extends $1\frac{1}{8}$ miles southeastward, consisting of two rocks about 150 feet high and another about 70 feet high midway between them, and a multitude of low rocks close together. The outer pinnacle lies $18\frac{1}{2}$ miles 258° true (S W. by W. $\frac{1}{4}$ W. mag.) from Cape Pankof. Anchorage, with fairly good protection from westerly winds, can be made northeastward of this reef, about $\frac{1}{2}$ mile southward of a bunch of rocks lying $\frac{3}{8}$ mile off the eastern side of the cape, in 10 fathoms, sandy bottom. A rocky islet about 130 feet high lies $1\frac{1}{2}$ miles westward of the cape and $\frac{5}{8}$ mile from the beach.

From Cape Lazaref the coast trends westward, curving gradually southward for about 30 miles, forming a broad, open bight called **Unimak Bay**, having a sandy beach. This sand beach is broken by a lava bed $8\frac{1}{2}$ miles westward of Cape Lazaref, and by three conical hills, the southernmost reaching the water and formed into several columns, making a small projection (**Rukavitsie Cape**), 15 miles westward of Cape Lazaref. At the southern end of the sand beach there is a broad valley, the south point of which is a sharp projection, with steep sides and about 350 feet high, which forms a small cove (**Promontory Cove**) open northward, which is reported to afford anchorage with protection from southerly winds but not from the swell. The bottom is sandy and the shoaling toward the beach gradual.

Cape Lutke, $2\frac{1}{2}$ miles southward of Promontory Cove, is a cliff 538 feet high, joined by a lower ridge to the higher land farther back, and is the southwestern head of Unimak Bay. At this point the coast changes direction to southwestward and then westward for 13 miles to Seal Cape.

Arch Point, 3 miles northeastward of Seal Cape, is a rocky projection 40 feet high with an arch through the extremity of the point.

Promontory Hill (see view), 5 miles northeastward from Seal Cape, is a short ridge, about 1,130 feet high, having a northwest and southeast direction, and detached from the interior high land. Its outlines are smoothly rounded and there is a slight saddle in the ridge, the whole having a bare, brown appearance. It is isolated and prominent, and together with Scotch Cap is a good landmark for the eastern entrance to Unimak Pass.

Seal Cape is not particularly noticeable, but the locality is well marked by Promontory Hill, Arch Point, and Scotch Cap.

From Seal Cape around to Cape Sarichef, a distance of 19 miles, the coast of Unimak Island has a number of projecting points, is low in appearance, and slopes gradually upward to the high land of the island. There are low bluffs in places, but none so high as Scotch Cap or which can be mistaken for it. There are no dangers if the coast be given a berth of $\frac{1}{2}$ mile.

Scotch Cap lighthouse is about $1\frac{3}{4}$ miles eastward of Scotch Cap in approximately latitude $54^\circ 24' N.$, longitude $164^\circ 45' W.$ The structure is a white, octagonal building and tower, and there are a number of buildings near it. The light is fixed white, third order, elevated 90 feet above high water, and should be visible 15 miles in clear weather when bearing from 277° true (W. by S. mag.) through north to 108° true (E. mag.). The fog signal is a 10-inch compressed-air whistle giving blasts of 5 seconds' duration separated by silent intervals of 55 seconds.

Scotch Cap (see view) is a precipitous cliff of rock which extends along the beach nearly 1 mile. It is 420 feet high at its highest point and becomes lower at either end. Back of the face of the cliff the land slopes downward for nearly 1 mile, and then rises by a uniform slope to the higher land of the island. In front of the cliff, 50 yards from its foot, is a large pinnacle rock 172 feet high. Scotch Cap can be seen many miles in clear weather and is unmistakable.

Cape Sarichef, the western end of Unimak Island, is the eastern point at the northwestern entrance to Unimak Pass. The cape is about 100 feet high, with steep grassy sides,

and the land back of the cape slopes gradually upward to Pogronni Voleano. There is a black lava bed along the beach south of the cape, and 2 miles south of the cape there is a flat rock barely detached from the coast.

Cape Sarichef lighthouse, on the summit of the cape, is in approximately latitude $54^{\circ} 36' N.$, longitude $164^{\circ} 56' W.$ The structure is a white, octagonal building and tower, and there are a number of buildings near it. The light is fixed white, third order, elevated $126\frac{1}{2}$ feet above the water, and should be visible $17\frac{1}{2}$ miles in clear weather when bearing from 16° true ($N. \frac{1}{8} W.$ mag.) through east to 218° true ($S. by W. \frac{3}{4} W.$ mag.). The fog signal is a first-class, compressed-air siren giving blasts of 3 seconds' duration separated by alternate silent intervals of 5 and 49 seconds.

DIRECTIONS FROM UMGA ISLAND THROUGH UNIMAK PASS TO CAPE KALEKTA.

The waters on the southern side of the Alaska Peninsula eastward of Umga Island have not been surveyed, but the general track of vessels through the inside passage is described in Coast and Geodetic Survey Bulletin No. 38. The directions following are based on surveys by parties of the Coast and Geodetic Survey in 1901.

I. *Umga Island to Seal Cape*.—Pass about $\frac{3}{4}$ mile westward of Umga Island and steer 225° true (**SSW. $\frac{3}{8} W.$ mag.**) for $14\frac{1}{2}$ miles, which should lead to a position $1\frac{1}{2}$ miles south-eastward of Cape Pankof. On this course Pankof Breaker should be left $2\frac{1}{4}$ miles on the starboard hand.

From a position $1\frac{1}{2}$ miles southeastward of Cape Pankof make good a 253° true (**SW. $\frac{7}{8} W.$ mag.**) course. The southernmost pinnacle rock at Cape Lazaref should be left about $3\frac{1}{4}$ miles on the starboard hand, and the coast of the southern end of Unimak Island should be given a berth of about 2 miles. This course made good for 58 miles should lead to a position with Seal Cape on the starboard beam distant $2\frac{1}{2}$ miles; Scotch Cap lighthouse should then bear about 302° true (**WNW. $\frac{3}{4} W.$ mag.**) distant about 5 miles. Then follow the directions in section II.

II. *Through Unimak Pass to Akun Head*.—When crossing Unimak Pass the tidal current with a maximum velocity at strength of about 4 miles will be on the bow or quarter, and allowance must be made for it to make the course good (see page 13).

From a position $2\frac{1}{2}$ miles southeastward of Seal Cape with Scotch Cap lighthouse bearing 302° true (**WNW. $\frac{3}{4} W.$ mag.**) distant about 5 miles, make good a 268° true (**WSW. $\frac{1}{4} W.$ mag.**) course for 36 miles, which should lead to a position 2 miles 349° true (**NNW. $\frac{1}{2} W.$ mag.**) from Akun Head. Then follow the directions in section III. The course should lead 2 miles northward of the eastern headland at the north end of Akun Island when 5 miles from Akun Head.

III. *From Akun Head to Cape Kalekta*.—From a position 2 miles 349° true (**NNW. $\frac{1}{2} W.$ mag.**) from Akun Head make good a 249° true (**SW. $\frac{5}{8} W.$ mag.**) course for 14 miles to a position with the western head at the north end of Akutan Island bearing 141° true (**SE. by E. mag.**) distant 2 miles.

From this position make good a 224° true (**SSW. $\frac{3}{8} W.$ mag.**) course for $18\frac{1}{2}$ miles, which should lead to a position about 1 mile northwestward of Cape Kalekta. Then follow the directions for Unalaska Bay, page 24. In crossing from Akutan Island to Cape Kalekta care should be taken not to be set off the course by the tidal currents setting to or from Akutan and Unalga passes (see page 14).

FOX ISLANDS AND PASSES.

The three large islands, Unimak, Unalaska, Umnak, and their associated islands, lying westward of Alaska Peninsula, are known as the **Fox Islands**. The islands of this group are high, bare of trees, and generally grass-covered, and terminate generally at the water in precipitous cliffs. Most of them have numerous pinnacle rocks close to the shore. They

are frequented by birds in enormous numbers, and immense flocks of them are frequently met with when in their vicinity. The highest peaks which, in clear weather, are prominent landmarks for mariners are:

Shishaldin Volcano, on Unimak Island, 9,387 feet high, in latitude $54^{\circ} 45' 23''$ N. and longitude $163^{\circ} 58'$ W., is cone-shaped and very regular in outline, with faint wreaths of smoke and vapor at times drifting from its summit. It is for the most part snow-clad, except where the rocky cliffs and projections afford no lodgment.

Isanotski, on Unimak Island, in latitude $54^{\circ} 46'$ N. and longitude $163^{\circ} 43' 30''$ W., is seen close eastward of Shishaldin, very rugged, and having a broken or castellated double peak, the highest 8,088 feet high. The summit is bare and looks as though composed of great vertical rock masses.

Pogromni Volcano, about 8 miles from the western end of Unimak Island, in latitude $54^{\circ} 34' 16''$ N. and longitude $164^{\circ} 41' 30''$ W., is 6,500 feet high, a snow-clad, conical peak, vertical ridges cropping through the snow. Pogromni is a guiding landmark in clear weather in making Unimak Pass, both from southward and from Bering Sea.

Makushin Volcano, on the northwestern side of Unalaska Island, in latitude $53^{\circ} 52' 20''$ N. and longitude $166^{\circ} 50' 40''$ W. (approximately), is 5,691 feet high, and in clear weather is a prominent landmark for vessels bound to Dutch Harbor from Bering Sea.

These mountains are excellent landmarks if they can be seen, but in summer they are often obscured by fogs or low-lying clouds. The lower hills and islands and objects near the sea level generally furnish the available landmarks.

From southward and eastward, bound for Bering Sea, there are three passes used by deep-draft vessels, known collectively as the **Fox Islands Passes**, and respectively as Unimak, Akutan, and Unalga passes. The largest and most desirable one to use in thick and foggy weather is the eastern one, Unimak Pass. This is clear of hidden dangers, the widest of the three, and is comparatively free from tide rips. It is especially recommended for sailing vessels, and for steamers bound northward direct. Akutan and Unalga passes are convenient, with daylight and clear weather, for steam vessels bound to Unalaska Bay, but, being narrow and having strong currents and tide rips at times, are not recommended for sailing vessels bound north. A fair wind is almost necessary for the passage, and from southward this would bring thick weather. The minor passes between the islands westward of Unimak Pass are described under their several headings following.

Soundings.—Southward of the passes the 100-fathom curve is 20 to 40 miles offshore, and when inside of this depth the color of the water will have changed from dark blue to light green. This change in the color of the water is the best indication the mariner has in thick weather to warn him of his approach to land and that he is on soundings. Southwest of Unimak Pass the 50-fathom curve is 3 to 5 miles offshore, and in thick weather the greatest caution should be used in approaching inside of this depth. Southeast of Unimak Pass the water shoals rapidly from 100 fathoms to Davidson Bank, on which a least depth of 36 fathoms is marked 27 miles from Ugamak Island.

Tidal Currents and Tide Rips.—In the vicinity of the passes the tidal currents have considerable velocity, and their direction and times of change are uncertain; they are also greatly influenced by winds. In navigating near the entrances to the passes the current should be kept in mind and precautions be taken to guard against being carried into dangerous localities, especially in thick weather.

In **Unimak Pass** the observed maximum velocity of the current is about 4 miles per hour, and its velocity is greater near Scotch Cap and Ugamak Island than in the middle of the pass. The northerly (flood) current begins about three hours before the time of high water at Kodiak and the southerly (ebb) current begins about three hours before the time of low water at Kodiak as taken from the Coast and Geodetic Survey Tide Tables. The tide rips, during the largest tides and when a strong wind opposes the current, are strong but not dangerous to well-found sailing vessels or steamers.

In **Akutan Pass** the currents have an estimated maximum velocity of 6 to 7 miles per hour. The northerly (flood) current begins about three hours before the time-of high water at Kodiak and the southerly (ebb) current begins about three hours before the time of low water at Kodiak as taken from the Coast and Geodetic Survey Tide Tables. There are strong tide rips during the periods of largest tides; but the strongest rips are not generally found in the middle of the pass. With a current setting northward the rips will be strongest in the northern entrance from Cape Kalekta and Akutan Island to Unalga Island, and with a current setting southward the strongest rips will be found at the southern entrance to the pass. When the current setting north is opposed by a strong northerly wind the tide rips in the northern entrance to the pass are dangerous, and it is advisable not to use this pass in a gale. Under ordinary conditions, when there are no strong winds, this pass can be used by full-powered steamers at any stage of the current, but sailing vessels should not use it unless they happen to enter at or near slack water. It is stated that the most dangerous rips occur at the north entrance to the pass.

In **Unalga Pass** the currents have an estimated maximum velocity of about 9 miles an hour, and the times for the beginning of flood and ebb currents are the same as for Akutan Pass. The tide rips prevail under the same general conditions as in Akutan Pass, except that they are, if anything, heavier and more dangerous in a gale.

The duration of both flood and ebb is subject to considerable variation in these passes, so that too much reliance should not be placed upon the times given above.

Assistant J. J. Gilbert, commanding Coast and Geodetic Survey steamer Pathfinder, who surveyed the Fox Islands Passes in 1901, states that "they [tide rips in Akutan and Unalga passes] occur during spring tides, when the currents are strong, and usually when there is a strong wind or swell from the other direction; this condition is not indispensable, for, on one occasion, there was neither wind nor sea, when suddenly we were in the midst of the rips, and had wet things pretty thoroughly before the hawse pipes could be closed."

When the tide rips are heaviest in Akutan and Unalga passes, the water is broken into heavy choppy seas from all directions, which board the vessel and make it difficult to keep control even of large, powerful steamers.

The general condition of **fog** and **weather** described on page 27 apply also to the vicinity of the Fox Islands Passes.

GENERAL DIRECTIONS FOR APPROACHING UNIMAK PASS FROM SOUTHEASTWARD.

Note.—In the directions following no allowance has been made for the tidal currents, which have considerable velocity in Unimak Pass; this should be kept in mind in order to make the courses good.

Unimak Pass is the widest of the Fox Islands Passes, being about 10 miles wide at its narrowest part, between Ugamak Island and Scotch Cap. It is free from outlying dangers and dangerous tide rips, and the tidal currents have less velocity than in the other passes. Except near the shores, it is free from williwaws. It is the most desirable pass for sailing vessels and for vessels not calling at Dutch Harbor. The directions for approaching this pass are also good for vessels desiring to pass through Akutan and Unalga passes.

When approaching the passes from southward and eastward, care must be taken to avoid the Sannak Reefs and the reported localities of Anderson and Lenard rocks. A good rule is to make longitude 164° W. while still south of latitude 54° N. and then stand northwestward to make Seal Cape. If the weather is very clear the mountains of Unimak Island may be seen and recognized and the course shaped for Unimak Pass; but under ordinary conditions Promontory Hill back of Seal Cape, Tigalda Island, or Ugamak Island, will be the first land sighted.

If Tigalda Island is sighted at a distance when approaching Unimak Pass, it will appear as a number of small, detached islands, but when seen closer to it is one island with six distinct mountain ridges.

A 355° true (**NNW.** mag.) course heading for Pogromni Volcano will lead nearly for Seal Cape, passing about 4 miles eastward of Ugamak Island.

If the weather is thick, soundings on Davidson Bank may be of use in feeling the way in to the land. In the vicinity of Seal Cape the coast is bold and may be approached with caution close enough (from $\frac{1}{2}$ to $\frac{3}{4}$ mile) to be seen and to be followed until some point is recognized by which the vessel's position may be known. A vessel should first be sure of her position before attempting to enter Unimak Pass and in thick weather should not attempt the other passes.

In thick weather, if the land is made in the vicinity of Seal Cape a vessel may stand westward, following the beach and giving it a berth of $\frac{3}{4}$ mile or more until Scotch Cap lighthouse or Scotch Cap is made and recognized. With Scotch Cap lighthouse bearing 18° true (**N.** mag.), distant 1 to 2 miles, steer 288° true (**W.** mag.) for 6 miles, and then steer 333° true (**NW.** mag.), which should give the coast of Unimak Island a berth of about $2\frac{1}{2}$ miles, and the course made good for about 11 miles should lead to a position 5 miles 254° true (**SW. by W.** mag.) from Cape Sarichef. Or, if bound to Unalaska Bay, when Scotch Cap lighthouse bears 18° true (**N.** mag.), distant 1 to 2 miles, a 266° true (**WSW.** mag.) course made good for 31 miles should lead about 2 miles northward of Akun Head.

In coming from southeastward, when Ugamak Island is sighted shape the course to pass about 2 miles northeastward of it, and then:

From a position 2 miles 63° true (**NE.** mag.) from the northeast end of Ugamak Island make good a 322° true (**NW. by W.** mag.) course for 10 miles to a position with Scotch Cap lighthouse bearing 74° true (**NE. by E.** mag.), distant $5\frac{1}{4}$ miles. Then steer 333° true (**NW.** mag.), with the northeastern end of Ugamak Island astern, and give the coast of Unimak Island a berth of about $2\frac{1}{2}$ miles; this course made good for $13\frac{1}{2}$ miles should lead to a position with Cape Sarichef lighthouse bearing 74° true (**NE. by E.** mag.), distant 5 miles. Then follow the directions for Bering Sea on page 47.

Or, if bound to Unalaska Bay, from a position 2 miles 18° true (**N.** mag.) of the northeast end of Ugamak Island make good a 280° true (**W. $\frac{3}{4}$ S.** mag.) course for 26 miles, which should lead to a position 2 miles northward of the eastern head at the north end of Akun Island. Then steer 268° true (**WSW. $\frac{1}{4}$ W.** mag.) about 5 miles to a position 2 miles 349° true (**NNW. $\frac{1}{2}$ W.** mag.) from Akun Head. Then follow the directions in section III, page 12.

UGAMAK ISLAND,

on the southwest side at the southeast entrance to Unimak Pass, lies 10 miles southward of Unimak Island, and its southeast point is in latitude 54° 13' N., longitude 164° 46' W. The island is rugged with cliffs at the shore, and 1,000 feet high at the eastern end, where there is a sharp peak. Near the middle of the island there is a knob nearly as high as the eastern end. The island is fringed with kelp and bare rocks close-to, but there are no known outlying dangers. There is no harbor at the island. **Aiktak Island** lies $\frac{1}{2}$ mile southward of Ugamak Island; its south side is a cliff about 600 feet high.

Ugamak Strait, between Ugamak and Aiktak islands on the north and Kaligagan Island on the south, has a width of 3 miles, and there are no known hidden dangers. Passing 1 mile southward of Aiktak Island, a 290° true (**W. $\frac{1}{4}$ N.** mag.) course, heading for the north end of Akun Island is considered safe, and carries through the passage in mid-channel.

TIGALDA ISLAND,

the south side of which is in latitude 54° 04' N., is separated from Ugamak Island by Ugamak Strait. The island is 11 miles long and about $3\frac{1}{2}$ miles wide, and consists of six mountain ridges, 1,200 to 1,800 feet high, separated by low valleys having a northwesterly direction. The western end of the island is comparatively low. **Kaligagan Island**, lying in Ugamak Strait $\frac{3}{4}$ mile off the northeast end of Tigalda Island, is $\frac{3}{4}$ mile long and about 300 feet high. A large number of high, bare rocks extend $2\frac{1}{2}$ miles westward of Kaligagan Island, and the

outermost lies $1\frac{3}{4}$ miles from Tigalda Island. Two rounded rocks lie $\frac{1}{2}$ mile off the south side of Tigalda Island, and an islet 100 feet high lies close to the island midway between these rocks and the western end of Tigalda Island.

Tigalda Bay, on the north side of Tigalda Island 3 miles from its eastern end, is a sheltered anchorage except from northwest winds. The bay is about $\frac{5}{8}$ mile wide, and $1\frac{1}{2}$ miles long in a 108° true (*E. mag.*) direction, and has depths of 8 to 10 fathoms, rocky bottom. The mean rise and fall of tides is 0.9 foot.

To enter *Tigalda Bay*, from Ugamak Strait, pass $\frac{1}{2}$ mile or more northward and westward of the outermost bare rock, lying $2\frac{1}{2}$ miles westward of Kaligagan Island, and steer 204° true (*S. $\frac{1}{2}$ W. mag.*) for $2\frac{1}{4}$ miles. Tigalda Bay should then be open on the port beam. Enter the bay in mid-channel and select anchorage near the middle, taking care not to approach the head nearer than about $\frac{3}{8}$ mile.

Approaching from southwestward through *Avatanak Strait*, follow the north side of Tigalda Island, giving it a berth of about 1 mile until heading about 112° true (*E. $\frac{3}{8}$ S. mag.*) for the entrance to the bay; on this course Tanginak Islet, about 80 feet high, should be astern and the highest peak (1,400 feet) close to the east end of Tigalda Island should be ahead. Enter the bay and anchor as directed in the preceding paragraph.

Derbin Strait, separating Tigalda and Avatanak islands, is a little over 1 mile wide, and there are no known hidden dangers. A mid-channel course through the strait, 326° true (*NW. $\frac{1}{2}$ W. mag.*), with the northeast headland of Akun Island ahead, is considered safe.

AVATANAK ISLAND,

lying southwestward of Tigalda Island, is separated from Akun Island by **Avatanak Strait**. The island is about 9 miles long and over 3 miles wide at its eastern end, but the western half of the island averages less than $\frac{3}{4}$ mile wide. The middle of the island is a great depression whose sides slope gently upward to the mountains at its eastern and western ends, which are about 1,700 and 1,500 feet high, respectively. Clusters of bare rocks extend about $\frac{3}{8}$ mile off the southeast and west ends of the island, and Basalt Rock about 30 feet high lies in Avatanak Strait, about 1 mile off the north side of the island. There is no secure anchorage.

Rootok Strait, separating Avatanak Island from **Rootok Island**, is a little over 1 mile wide in its narrowest part, but the clear channel is reduced by rocks on both sides to a width of about $\frac{1}{2}$ mile; there are no known hidden dangers when passing through in mid-channel. The directions following are considered safe and lead in mid-channel.

Approaching from southeastward, steer for the north end of Rootok Island on a 299° true (*W. by N. mag.*) course, leaving the east end of the island $\frac{5}{8}$ mile on the port hand. When the west end of Avatanak Island bears abeam, steer about 332° true (*NW. mag.*) and pass in mid-channel between the bare rocks off the west end of Avatanak Island and those close to the north end of Rootok Island.

ROOTOK ISLAND

is the western island on the southeast side of Avatanak Strait, and lies 3 miles southeastward from the southern end of Akun Island. The island is 3 miles long and about 2 miles wide. There are three peaks on its southern side, the highest 1,760 feet, and the island terminates at the shore in cliffs. There is no secure anchorage. The southern ends of Tigalda, Avatanak, and Rootok islands are nearly in line, bearing 262° true (*S W. by W. $\frac{3}{4}$ W. mag.*).

Avatanak Strait is a broad, clear channel separating Avatanak and Rootok islands from Akun Island, and leads from Unimak Pass for Akutan Pass. The strait has a general 245° true (*S W. $\frac{1}{4}$ W. mag.*) direction, and is 3 miles wide at its narrowest part. There are no known hidden dangers, and its navigation is not difficult in clear weather.

Current observations have not been made in Avatanak Strait. The flood current sets northeastward and the ebb southwestward through the strait.



AKUN ISLAND

lies 23 miles southwestward of Unimak Island, and is separated from Akutan Island by Akutan Bay and Akun Strait, and from Rootok and Avatanak islands by Avatanak Strait. It is about 12 miles long, but is very irregular in shape, being nearly divided by Akun Cove and Lost Harbor and a low depression joining them. The island is high and rugged, particularly its northern part, which reaches an elevation of about 2,500 feet in an extinct crater at its northwest end on the north side of Lost Harbor. The northern end of Akun Island is two massive heads about 4 miles apart, separated by Little Bay with a moderately low divide at its head, the whole forming a large valley. Both heads have precipitous sea faces about 1,200 feet high, and have grassy saddles southward of them. **Akun Head**, the western headland, has a long lozenge-shaped horizontal strata with a red iron-rust color in the face of the cliff. **Tanginak Islet**, about 80 feet high with steep sides, lies $2\frac{1}{4}$ miles off the east end of Akun Island, and there is a deep passage between if the east end of Akun Island be given a berth of over $\frac{5}{8}$ mile. **Tangik** and **Poa** islands (about 200 feet high) lie in Avatanak Strait about $\frac{3}{4}$ mile off the southern side of Akun Island. Two low islets surrounded by kelp lie on the eastern side at the northern end of Akun Strait close to the southwest end of Akun Island. There are a number of anchorages around the island with offshore winds. The best are:

Seredka Bay, on the south side of Akun Island 2 miles westward of Round Head, the southeast point of the island, and $1\frac{1}{2}$ miles northward of Tangik Island, is about 1 mile wide and the same long, open southeast, and has two bights at the head. The bay is easy of access, and a safe and roomy anchorage except with southeast winds. There is considerable kelp on the southwest side of the bay. The *Pathfinder* anchored in the bight at the north end of the bay, with the east end of Tangik Island shut out by the south point at the entrance to the bay.

Akun Cove is the broad indentation in the northeast side of Akun Island; it affords anchorage at its head except with winds from southeast to northwest, but heavy williwaws are experienced with offshore winds. The bay is 5 miles wide at its entrance and about 4 miles long. At its head, where the bay is $2\frac{1}{2}$ miles wide, there are two large bights. Anchorage may be made in either of the bights, about $\frac{1}{2}$ mile from shore, in 10 to 15 fathoms. There are no known dangers in the bay except close to shore. There are fresh-water lakes at the heads of the bights, about 10 feet above high water, and there is a very low depression from the head of the northern bight to Lost Harbor.

Lost Harbor has its entrance from Akutan Bay on the western side of Akun Island about 6 miles southward of Akun Head. It is a good harbor, sheltered from all except southwest winds, and is large and easily entered. The harbor has a uniform width of $1\frac{1}{2}$ miles and is nearly 3 miles long in a 63° true (*NE. mag.*) direction.

Approaching Lost Harbor from westward pass about 1 mile northward of North Head (of Akutan Island) and make good a 102° true (*E. $\frac{1}{2}$ N. mag.*) course for 10 miles, which should lead to the middle of the entrance. Then steer about 57° true (*NE. $\frac{1}{2}$ N. mag.*), following a mid-channel course into the harbor, and taking care to give the northwest shore of the harbor a berth of $\frac{5}{8}$ mile or more until near the head. When about $\frac{3}{4}$ mile from the head of the harbor haul up to about 332° true (*NW. mag.*) and anchor about $\frac{1}{2}$ mile from shore at the northwest end of the head of the harbor, in about 10 fathoms.

Approaching from northward around Akun Head, follow the western shore of Akun Island at a distance of about 1 mile until in the middle of the entrance to Lost Harbor, and then proceed as directed in the preceding paragraph to the anchorage.

AKUTAN ISLAND,

the largest between Unalaska Island and Unimak Pass, is about 15 miles long in a general east and west direction, and its greatest width in a north and south direction is about 10 miles. The island lies about 9 miles northeastward from Unalaska Island and is separated from the latter by Akutan and Unalga passes. **Akutan Peak**, 4,100 feet high, is a little west of the middle

of the island and its highest point. On the northeast side the island is separated from Akun Island by Akutan Bay and Akun Strait; the latter is about $\frac{3}{4}$ mile wide, but the ledges on both sides leave a channel about 600 yards wide at its narrowest part with a depth of about 7 fathoms. There are strong tide rips in this channel, and it is not recommended. As far as known there are no dangers over $\frac{1}{2}$ mile from the shore of the island, except the reef on its northwest side.

North Head is a high, bold cliff, with a large, deep, grassy valley in the otherwise high shore on its east side. About 2 miles southwestward of the cape there is a narrow, grassy valley which separates the high ridge of North Head from another high ridge; the western side of the valley is a bluff.

Lava Point, 6 miles southwestward of North Head, is moderately low lava beds. At the end of the point is a flat rock having the same height as the point and slightly detached from it.

A reef, bare at low water and covered with kelp, extends $\frac{5}{8}$ mile from the western side of Akutan Island at a point $2\frac{1}{2}$ miles southward of Lava Point.

Cape Morgan, the southwest end of the island and on the north side of Akutan Pass, is steep and high. Three pinnacle rocks, 4 to 8 feet high, lie in the pass 600 yards off the cape, and other bare rocks extend the same distance off its southeast side. The cape should be given a berth of over $\frac{1}{4}$ mile.

Battery Point (see view), the south end of Akutan Island, is prominent, steep, and high, and is surrounded by bare rocks close-to.

There are a number of places where vessels may anchor with an offshore wind; but they are open seaward and are not recommended. Akutan Harbor is the only secure anchorage.

Vulcan Cove, about 3 miles northeastward of Battery Point, affords shelter in northerly weather, but is open to the Pacific swell.

Hotsprings Bay is a wide indentation in Akutan Island open northward between North Head and Akutan Harbor. The north point at the entrance is a high, rocky cliff. The south point at the entrance, Ridge Point, lying about $2\frac{1}{2}$ miles southeastward from the north point at the entrance, is a narrow ridge about 150 feet high, which has bare rock cliffs on its west side, but slopes rapidly on its east side into a grassy valley and Sandy Cove. At the head of the bay are three bights having streams, and the southernmost has hot springs about 1 mile up the stream. No directions can be given for anchoring in the bay, except that the anchorage is reported to be in 15 to 20 fathoms, sandy bottom. A kelp patch extends a short distance into the bay from the south point at the entrance.

Akutan Harbor is on the north side of the island near its eastern end. The harbor is entered from northward through Akutan Bay; it is nearly $3\frac{3}{4}$ miles long and $\frac{1}{2}$ to $1\frac{3}{4}$ miles wide. There are no known dangers over 300 yards from the shore. There is anchorage off the north shore abreast an Aleut village about $1\frac{5}{8}$ miles westward of the north point at the entrance and about 300 yards from the shore in about 22 fathoms. A vessel may also anchor in the broad bight in the south shore in 15 fathoms, with the north point at the entrance bearing about 17° true (N. mag.) and taking care to keep clear of the kelp.

Approaching Akutan Harbor from Akun Head, follow the northwest shore of Akun Island giving it a berth of about 1 mile until abreast the old crater on the island, and then steer about 178° true (S. by E. $\frac{3}{4}$ E. mag.) with Akun Strait on the port bow. The north point at the entrance to Akutan Harbor will be a little on the starboard bow (this point is a grassy hummock over 100 feet high and is connected with the mainland of Akutan Island by a low, grassy spit). Steer so as to leave this point over $\frac{1}{4}$ mile on the starboard hand, round it at this distance, and then steer 251° true (SW. $\frac{3}{4}$ W. mag.) into the harbor, giving the shores a berth of over 300 yards. Anchor off the village, taking care to allow the vessel swinging room.

Passing north of North Head (of Akutan Island) leave it about 1 mile on the starboard hand and steer about 107° true (E. mag.), giving the shore of the island a berth of 1 mile on the starboard hand. Having stood on this course about 6 miles and when Ridge Point bears on the starboard beam distant 2 miles, steer 150° true (SE. $\frac{1}{4}$ E. mag.) about 4 miles; the north

point at the entrance to Akutan Harbor should then be forward of the starboard beam distant nearly $\frac{3}{4}$ mile; steer so as to leave the point over $\frac{1}{4}$ mile on the starboard hand and enter the harbor as directed in the preceding paragraph.

AKUTAN PASS

is $2\frac{1}{2}$ miles wide in its narrowest part. There are six small islets, Baby Islands, on the western side of the pass, with many detached rocks above water in the same group, but not extending beyond the islets into the pass. Cape Morgan, on the north side of the pass, should be given a berth of over $\frac{1}{2}$ mile. The breaker reported in the middle of Akutan Pass was searched for and does not exist. The current and tide rips (see page 14) are not so strong as in Unalga Pass. On this account, and because of its greater width and the fact that a straight course will carry through, this pass is preferred by many to Unalga Pass.

Akutan Pass is recommended, in the daytime with clear weather, for steamers bound to or from Unalaska Bay, and for sailing vessels from Unalaska Bay with a fair wind. From southward it is recommended to make the land in the vicinity of Tigalda Island and Avatanak Island and follow along the south side of these islands until the course is shaped from Rootok Island to Cape Morgan. A mid-channel course through the pass is recommended as the most prudent one.

DIRECTIONS FOR AKUTAN PASS.

From a position 3 miles southward of Rootok Island a course 280° true (W. $\frac{5}{8}$ S. mag.) made good for 17 miles will lead $1\frac{5}{8}$ miles southward of Battery Point and to a mid-channel position in the pass between Cape Morgan and Baby Islands. Continue the course 3 miles past Cape Morgan to a position 2 miles off the north side of Unalga Island, and then steer 269° true (WSW. $\frac{3}{8}$ W. mag.) with Battery Point astern. This course made good for 8 miles will lead to a position $1\frac{1}{4}$ miles northward of Cape Kalekta.

UNALGA ISLAND

lies northeastward of Unalaska Island nearly halfway to Akutan Island; Akutan Pass leads between Unalga Island and Akutan Island, and Unalga Pass leads between Unalga Island and Unalaska Island. Unalga Island is about $4\frac{1}{2}$ miles long east and west, about $2\frac{1}{2}$ miles wide and 650 feet high, covered with high grass. Lying north of the eastern end of the island is a group of six small islands known as Baby Islands; between these and Unalga Island there is a kelp-bordered passage (Baby Pass) about $\frac{3}{4}$ mile wide with a reported depth of 11 fathoms. The southern and western shores of Unalga Island bordering on Unalga Pass are free from outlying dangers; but it is advisable to give them a berth of at least $\frac{3}{8}$ mile.

Unalga Cove, on the northwest side of Unalga Island, is about $\frac{5}{8}$ mile in diameter and affords shelter in southerly weather. No directions are necessary except to keep in the middle of the cove and well clear of the kelp. The mean rise and fall of the tides is 1.2 feet.

UNALGA PASS,

between Unalga and Unalaska islands, is the narrowest of the three principally used passes, and has the strongest tidal currents. It is about $1\frac{1}{4}$ miles wide in its narrowest part, and, with the exception of rocks above water, which make out a short distance from the points of Unalaska Island, the pass is considered free from dangers. In the middle of the pass there are depths of 24 to 40 fathoms, with deeper water northwestward and southeastward. Its worst features are the strong tidal currents and tide rips, both of which are generally considered worse in this pass than in either of the other two; williwaws of great force are also experienced. The advantage of using this pass in thick weather is that the shore of Unalga Island is clear of dangers, and when made can be followed close enough to keep it in sight while going through.

The Signals, Egg Island, and Old Man are the prominent landmarks for making Unalga Pass from southeastward.

For currents and tide rips in the pass see page 14.

DIRECTIONS FOR UNALGA PASS.

From Southeastward.—Passing 3 miles southward of Rootok Island a course 261° true (SW. by W. $\frac{3}{4}$ W. mag.) made good for about 20 miles will lead to a position 2 miles off the south side of Unalga Island. Then steer about 292° true (W. $\frac{1}{2}$ N. mag.) to a position about $\frac{3}{4}$ mile off the southwest end of Unalga Island in the narrowest part of the pass.

Or, when Egg Island is recognized pass 2 to 3 miles northward of it, about midway between it and Unalga Island, and steer about 292° true (W. $\frac{1}{2}$ N. mag.) to a position about $\frac{3}{4}$ mile off the southwest end of Unalga Island in the narrowest part of the pass.

From a position about $\frac{3}{4}$ mile off the southwest end of Unalga Island make good a 329° true (NW. $\frac{1}{4}$ W. mag.) course for 3 miles to a position with Erskine Point 1 mile on the port beam. Then steer 297° true (W. $\frac{7}{8}$ N. mag.) for 4 miles and pass 1 mile northward of Cape Kalekta.

The above directions lead through the middle of the pass, and this is the safest course for any vessel to follow on account of the tide rips and strength of the current. The shore of Unalga Island, bordering Unalga Pass, as far as known, is free from dangers at a distance of $\frac{1}{4}$ mile from shore. On the southern side of the pass there are some rocks showing out of water, but not over $\frac{1}{4}$ mile from the shore.

UNALASKA ISLAND,

lying southwestward of Akutan Island and separated from the latter by Akutan and Unalga passes, is one of the three largest of the Aleutian Islands. The island is about 67 miles long, about 23 miles wide at its widest part, mountainous, and during the greater part of the year the mountains are covered with snow. **Makushin Volcano**, 5,691 feet high, the highest point on the island, is near its northwestern side about 25 miles from the eastern end of the island. The eastern end of Unalaska Island was surveyed in 1901, but the island west of Biorka Island and Unalaska Bay is still imperfectly known.

Biorka Island, close to the northeastern end of Unalaska Island and separated from the latter by a narrow, deep strait (Udagak Strait), appears as a part of Unalaska Island. A number of rocks lie 1 to $2\frac{3}{4}$ miles eastward of the eastern end of Biorka Island.

Egg Island is about $\frac{3}{4}$ mile in diameter, 550 feet high, and lies about $1\frac{1}{2}$ miles northeastward from the north point of Biorka Island. Lying a little over $\frac{3}{4}$ mile west of Egg Island are **Old Man Rocks**, two rocks surrounded by deep water; the higher is about 60 feet high and flat-topped, and the smaller is round-topped and lies a short distance north of the higher rock.

Egg Island Passage leads between Egg Island and Biorka Cape and southward of Old Man Rocks. This pass is nearly $1\frac{1}{2}$ miles wide and has a depth of about 35 fathoms in the middle. A 309° true (WNW. mag.) course passing midway between Egg Island and Biorka Cape leads through the middle of the pass.

The Signals are three small rocks. The outer is 50 feet high and lies nearly 3 miles southward from Egg Island. A small rock, 10 feet high and over which the sea washes, lies a little over $\frac{1}{4}$ mile eastward of the **Outer Signal**. The **Inner Signal** is 180 feet high and lies $\frac{7}{8}$ mile from the shore of Biorka Island and $4\frac{1}{2}$ miles south of Egg Island. There is apparently deep water between the Inner Signal and Outer Signal, but they should be approached with caution.

BEAVER INLET

makes in 17 miles in a 235° true (S W. $\frac{5}{8}$ S. mag.) direction in the northeastern end of Unalaska Island. Its entrance lies between Biorka Cape on the southeast and **Brundage Head** on the northwest and is approached from southward and eastward between Egg and Unalga islands. The least width of the inlet is $1\frac{5}{8}$ miles near its head and it has a clear and unobstructed channel its full length.

Udagak Strait separates Biorka Island from Unalaska Island; its entrance in Beaver Inlet is $9\frac{3}{4}$ miles southwestward from Old Man. This strait has a least width of $\frac{1}{4}$ mile, but has good water; there are some rocks off the south spit of the narrows which mark three points of a reef the limits of which are marked by kelp; one or more of the rocks are always visible. *To pass through the strait* follow a mid-channel track, giving the two gravel spits a good berth. There is an anchorage, sheltered from all winds, in **Udagak Bay**, an indentation in the west shore of the strait about $3\frac{1}{4}$ miles from its entrance in Beaver Inlet.

There are a number of bays making off from Beaver Inlet in which vessels may anchor, but those on the south side of the inlet are open northward and northwestward and those on the north side are open southward and eastward.

Udamat Bay, on the northwest side of Biorka Island, $5\frac{1}{2}$ miles southwestward from Old Man, extends $2\frac{3}{4}$ miles in a 186° true (*S. by E. mag.*) direction, has a general width of $\frac{3}{4}$ mile near its head, and has a deep and unobstructed channel. There is a small native village on the north side of the point at the east side of the entrance to the bay. Vessels may anchor in the southeastern end of the bay, taking care to have room to swing.

Strait Bay makes into Biorka Island from Beaver Inlet just east of Udagak Strait; the *Pathfinder* anchored in the head of this bay.

Amugul Bay makes southward from Beaver Inlet about 3 miles southwestward of the entrance to Udagak Strait. The *Pathfinder* anchored in a cove in the southwestern and broadest part of the bay. There is a small island on the eastern side of the entrance to the bay.

At the head of Beaver Inlet there are four small bays; named in order, following the south shore around to the north shore, they are **Tanaskan**, **Final**, **Kisselen**, and **Erskine**. The *Pathfinder* anchored near the head in Final and Erskine bays.

Uniktali Bay makes into the north shore of Beaver Inlet about 15 miles above its entrance; this bay is nearly 3 miles long in a westerly direction and $\frac{1}{4}$ mile wide at its narrowest part near its head.

Agamgik Bay and **Ugadaga Bay** are two indentations in the north shore of Beaver Inlet $5\frac{1}{2}$ and 8 miles, respectively, above the entrance of the inlet. From the head of Ugadaga Bay a trail leads to the village of Iliuliuk. There are rocks off the western point at the entrance to Agamgik Bay.

Deep Bay is the bight on the north side of the entrance to Beaver Inlet, and is protected from northeastward by a long ledge and several small islets which make off about $\frac{1}{2}$ mile from the shore. The *Pathfinder* anchored in the northwestern corner of the bay.

The places in Beaver Inlet where the *Pathfinder* anchored were used only as anchorages for the night while that vessel was engaged in surveying in the locality.

ENGLISH BAY

is a secure anchorage in the north side of Unalaska Island, directly south of the west end of Unalga Island. The best anchorage is nearly 2 miles above the entrance in about 6 or 7 fathoms; the width of the anchorage between the 5-fathom curves is here about 300 yards. There are bare rocks off both points at the entrance, between which the channel has a width of about $\frac{3}{8}$ mile. When about $1\frac{1}{4}$ miles above the entrance the western shore should be given a berth of over 400 yards to avoid a shoal with 1 to 3 fathoms over it which stretches along the shore $\frac{1}{2}$ mile. *In entering* care must be taken not to be set off the course by the strong currents in Unalga Pass, which have a maximum velocity of about 9 miles; follow a mid-channel track or favor the eastern shore and anchor in 6 to 7 fathoms in the middle of the bay nearly 2 miles above the entrance. Good holding ground in depths of 12 to 17 fathoms will be found $\frac{3}{4}$ to $1\frac{1}{2}$ miles inside the entrance. There is a small fishing village on the eastern point (Fisherman Point) at the entrance to the bay. From Fisherman Point eastward a little over 1 mile to Brundage Head, there are ledges and rocks which lie some distance from the shore.

KALEKTA BAY

is a broad, open bay in the north end of Unalaska Island just east of Unalaska Bay; it has no known dangers over 400 yards from the shore, and there are a number of places where a vessel may anchor; but as this bay is open northward and English Bay and Dutch Harbor are better harbors it is not recommended. There is a pinnacle rock off Erskine Point, the eastern point at the entrance, somewhat similar to Priest Rock: but this rock is distinguished by a smaller one between it and Erskine Point.

UNALASKA BAY

is the indentation making in to the north end of Unalaska Island between Cape Kalekta and Cape Cheerful. Commercially it is one of the most important bays in western Alaska. Its shores are generally mountainous, with precipitous sea faces. Amaknak Island lies in its southern end. Westward of the island the water is deep, but there is no good harbor in this part of the bay; eastward of the island are the important anchorages of Iliuliuk Bay, Dutch Harbor, and Iliuliuk Harbor. The channel to Iliuliuk Bay and Dutch Harbor is free from dangers, except along the shores. Iliuliuk Harbor is obstructed at its entrance by ledges, but with the aid of the buoy is not difficult to enter with a small vessel.

Cape Kalekta (see view), 500 feet high, is the eastern point at the entrance to Unalaska Bay. The extremity and western side of the cape are rugged, precipitous cliffs, with a few rocks but no beach at the water line. From the summit of the cape the land falls to the break at Constantine Bay, and then rises to higher land farther south. A dangerous ledge, usually marked by breakers, lies nearly $\frac{3}{4}$ mile northward of the cape. The cape should be given a berth of 1 mile or more to clear the ledge, as the strong tidal currents may tend to carry a vessel on it.

Priest Rock (see view), close-to off the northwest side of Cape Kalekta, is a pinnacle about 80 feet high.

Cape Cheerful, the western point at the entrance to Unalaska Bay, is made up of bold, very high headlands, rounded on top, and intersected by deep, grassy valleys. The shore is free from dangers and has deep water close-to. A cascade, 125 feet high, south of Cape Cheerful, can be seen from the vicinity of Cape Kalekta, and is sometimes useful in thick weather, when only the lower part of the land can be seen.

Ulakta Head, the north end of Amaknak Island, is 900 feet high. It has a flat top, and in clear weather it is one of the best landmarks for fixing the position of Unalaska Bay. From its northwest point a reef extends $\frac{1}{2}$ mile, marked by Needle Rock, similar in appearance to Priest Rock, but not so large. From its northeast point a long, narrow, grassy, shingle spit extends southward $1\frac{1}{2}$ miles; its southern end, called Spithead, is marked by a black and white wooden beacon which is liable to be destroyed by heavy gales. A shack stands on the spit, about midway its length.

Princes Head, 2 miles from Cape Kalekta, is a large, square-headed rock that projects from the shore far enough to be seen, even in thick weather, when following the east shore.

Constantine Bay, about 4 miles from Cape Kalekta, is obstructed by numerous ledges, many of which are only evident from the attached kelp. It is of no importance and should be avoided by all vessels.

Summer Bay, the large, shallow bight 3 miles from Constantine Bay and opposite Ulakta Head, is shoal, and its shores are lined with kelp-marked rocks and ledges. At its southern headland is Second Priest, about 60 feet high. The bay should be avoided by vessels.

Iliuliuk Bay extends from Second Priest and Ulakta Head to Iliuliuk. Northward of Spithead there is a ridge extending across the bay, with depths of 7 to 12 fathoms. South of this ridge the depths increase to 16 and 19 fathoms. There is anchorage anywhere in the bay. The usual anchorage is at the head in 14 to 16 fathoms, muddy bottom, where, even with northerly winds, the force of the sea does not seem to reach home. At the head of Iliuliuk



BATTERY POINT, AKUTAN ISLAND—FROM EASTWARD.



CAPE KALEKTA, W. $\frac{1}{2}$ S. 5 MILES. PRIEST ROCK.
UNALASKA ISLAND.



PRIEST ROCK, CAPE KALEKTA, NE. BY E., DISTANT 3 MILES.



Bay, behind the village, there is a ravine or break in the mountains, which extends through to the water southward. This is sometimes useful as a guide in entering the bay.

DUTCH HARBOR

is on the west side of Iliuliuk Bay. Its entrance is between Spithead and Rocky Point. The water is deep close to the shores and in all parts of the harbor, except off Rocky Point, where there is a reef making off a little less than $\frac{1}{4}$ mile, marked at its end by a black can buoy. The entrance between Spithead and the end of the reef off Rocky Point is about $\frac{1}{2}$ mile wide, with a depth of 18 fathoms. Anchorage may be had throughout the harbor in 14 to 19 fathoms. Violent williwaws are experienced during gales, especially from southwest, and the best shelter will be found under the high part of the island well northward of the wharf.

The headquarters of the North American Commercial Company for this part of Alaska are situated on the south side of Dutch Harbor. In front of their warehouses and coal depot a T-shaped wharf extends out to deep water. Large vessels can lie at the outer end, and there is ample room for small vessels on the inside of the T. The post office here is called Udakta.

Supplies.—Coal is kept for sale by the company, and can be obtained, delivered on the wharf, at \$10 to \$12 per ton, at the rate of 150 to 250 tons per day. Fresh water can be obtained from a hydrant on the wharf at $\frac{1}{2}$ cent per gallon.

The company's store carries a supply of ship chandlery and outfits, and is well stocked with canned goods and salt provisions. Fresh meats and provisions can be obtained at times.

There is a small machine shop and blacksmith shop, where light work can be done by the vessel's own force.

ILIULIUK HARBOR

is joined to the head of Iliuliuk Bay by the passage between Iliuliuk Reef and the village of Iliuliuk (Unalaska post office). The harbor is small and the channel leading into it narrow, and it is suitable only for small or moderate-sized vessels.

Channels.—The channel always used is the one southward of Iliuliuk Reef, on either side of Tuscarora Rock, and has a least depth of about 5 fathoms. The channel northward of Tuscarora Rock is straighter than that southward of it and is to be preferred. There is a channel north of Iliuliuk Reef, between it and North Rock, which has a least depth of 3 fathoms, but it should not be attempted except with local knowledge.

Anchorage.—Iliuliuk Harbor is small, but landlocked, with good holding ground, and an average depth of 10 fathoms. Violent williwaws are experienced with strong southwest gales. The headquarters of the Alaska Commercial Company are at Iliuliuk, and the company has a wharf projecting into the harbor at its entrance from the western end of the spit on which the village is located, with depths of $4\frac{1}{2}$ to $5\frac{1}{2}$ fathoms along its northwest face.

Iliuliuk is the original Russian settlement. There is a Greek church with a parochial school, also a Methodist mission school. The post office, United States deputy collector, and United States commissioner for this general locality are located here. The post office is called Unalaska.

Supplies, etc.—The Alaska Commercial Company has a well-stocked general store and commodious warehouses at Iliuliuk. Coal is kept on hand for sale, with similar facilities to those at Dutch Harbor for coaling. Fresh water can be obtained at the wharf, and boats can water on Amaknak Island, opposite the wharf. Lumber can usually be obtained in limited quantities.

Tides.—The mean rise and fall in Dutch Harbor is 2 feet. The tidal current in Dutch Harbor is inappreciable, and in Iliuliuk Harbor the velocity does not exceed 1 mile an hour.

Ice.—The bay is open to navigation at all seasons. It is reported that on two occasions the drift ice of Bering Sea entered Unalaska Bay, but such an occurrence is so rare that it need not be considered. Ice often forms in the sheltered coves and harbors in cold, calm weather, but it never attains any thickness or interferes with navigation.

DIRECTIONS FOR UNALASKA BAY.

When bound for Unalaska Bay from any part of Bering Sea, it is recommended to shape the course for Cape Cheerful. In thick weather it is better to fall westward of Cape Cheerful and then round it than to fall eastward of it and get down into the passes. **Makushin Volcano**, 5,691 feet high, can generally be seen in clear weather, and is prominent. An extinct crater, 2,314 feet high, back of Cape Cheerful and west of Eider Point, gives a distinct point for which to steer until close enough to distinguish the surrounding features. On getting close to the island, when the fog hangs over the land but leaves a clear space just along the water's edge, **Wislow Island** forms a good mark. It is in a small bay about 2 miles westward of Cape Cheerful, and is a small, rounded island, regular in shape, and stands far enough from the land to be seen as not a part of the main island. Westward, under similar conditions, **Makushin Cape** can be seen at times. The land slopes gently to the cape from Makushin Volcano, and ends in a small peak-like formation. From eastward the **cascade** south of Cape Cheerful is also useful as a mark. Strangers, when in the vicinity and uncertain of the identity of the bay and its landmarks, should endeavor to pick out **Ulakta Head**. Looking into the bay, its flat top breaking off abruptly to sloping sides presents an appearance unlike any other in the vicinity, and shows up well against the background of mountains. When sighted, steer for it, leave it on the starboard hand, and follow around, keeping out of kelp.

Cape Kalekta to anchorage.—Having arrived in the vicinity of Cape Kalekta, give it a berth of over 1 mile in rounding it, and steer for Ulakta Head, course 214° true (**S. by W. $\frac{1}{2}$ W. mag.**) about 4 miles. When the south point at the entrance to Constantine Bay is abeam, distant 1 mile, change course to 195° true (**S. $\frac{1}{4}$ E. mag.**) for about $3\frac{1}{2}$ miles to a mid-channel position in Iliuliuk Bay eastward of Ulakta Head. Then follow a mid-channel course through Iliuliuk Bay, course about 220° true (**SSW. mag.**), and anchor $\frac{1}{4}$ to $\frac{1}{2}$ mile from the head of the bay in 14 to 16 fathoms, muddy bottom.

To enter Dutch Harbor pass between Spithead and the buoy off Rocky Point, and anchor in the harbor as desired in about 18 fathoms, muddy bottom.

At night the spit is difficult to make out, and the following may be useful: Stand through Iliuliuk Bay in mid-channel, taking care to keep clear of the reef on the eastern side of the spit, and when the lowest part of Amaknak Island, at the southwest end of Dutch Harbor, bears 276° true (**W. by S. mag.**) steer for it, keeping the bearing, which leads in mid-channel between Spithead and Rocky Point buoy. On this course the high mountain on the eastern side, south of Summer Bay, should be directly astern.

To enter Iliuliuk Harbor, stand southward through Iliuliuk Bay on the 220° true (**SSW. mag.**) course until the buoy or kelp marking Tuscorara Rock is sighted. Then haul westward and pass the buoy close-to on either side, keeping out of the kelp. Both Tuscorara Rock and Iliuliuk Reef are marked by kelp, which, with care, serves as a guide if the buoy is not in place. When clear of Tuscorara Rock haul northward to pass in mid-channel southward of the dry rocks of Iliuliuk Reef and pass close to the north corner of the wharf. Small vessels may anchor in the middle of the harbor in 10 fathoms; the western side of the harbor should be given a berth of over 100 yards.

Remarks.—Sailing vessels entering Dutch Harbor should carry sufficient sail to keep good way on until past the beacon on Spithead. It has frequently occurred that vessels, shortening sail at Ulakta Head, have been set toward the shoal on the east side of the spit owing to little headway and the wind drawing ahead. They are then obliged to anchor in an exposed place, and steam assistance is not always available.

The 214° true (**S. by W. $\frac{1}{2}$ W. mag.**) course from Cape Kalekta follows the shore northward of Constantine Bay at a distance of about 1 mile. In thick weather, when following the east shore, care must be taken not to enter Constantine or Summer bays by mistake. This has sometimes occurred when the opposite headland could not be made out. If passing southward of Tuscorara Rock, vessels are obliged to make a sharp turn westward, and care should be observed.

Dangers.—A large cluster of rocks, mostly awash, and usually marked by breakers, extends nearly 200 yards westward of the south head of **Constantine Bay**.

Second Priest, near the south point of Summer Bay, is surrounded by reefs, awash and under water, for a distance of 300 yards. Between Second Priest and a point opposite the entrance to Dutch Harbor the east shore is fringed with rocks and should not be approached closer than $\frac{1}{4}$ mile.

The spit has a kelp-marked shoal on its east side which extends its whole length; at its middle point the shoal extends $\frac{1}{4}$ mile from shore. Spithead is bold-to, and may be safely approached as close as 150 yards.

Rocky Point has a kelp-marked reef which extends toward Spithead about 350 yards; eastward of the point the shoal makes out about 200 yards with little kelp. The north-eastern extremity of the reef is marked by a buoy (can, black, No. 1) in 7 fathoms.

From Rocky Point south, the shore of Amaknak Island should not be approached closer than 300 yards.

Iliuliuk Reef is a ledge, portions of which are always exposed, extending 250 yards in an east and west direction. From the eastern dry rock a ledge, with 12 to 15 feet over it and marked by kelp, extends 150 yards 177° true (S. by E. $\frac{3}{4}$ E. mag.)

Tuscarora Rock is a 3-fathom spot, having some kelp, which lies about 60 yards 169° true (SSE. $\frac{1}{2}$ E. mag.) from the southern extremity of Iliuliuk Reef. It is of small extent and is marked by a buoy (nun, red, No. 2). The 3-fathom curve on the edge of the shoal making out from the shore is about 60 yards southward of Tuscarora Rock, and is sometimes marked by a small black buoy.

BERING SEA.

The portions of Bering Sea here treated include the coast and islands of Alaska northward of the Aleutian Islands. Excepting a few localities, this territory has not been surveyed, and the charts of it are only compilations from various sources, with corrections made from later information received; the charts are necessarily imperfect and must not be followed implicitly, especially when in the vicinity of the coast. Then, too, the currents are much influenced by the winds, and are imperfectly known and difficult to predict, so that positions by dead reckoning are uncertain and safety depends upon constant vigilance.

Northward and eastward of the 100-fathom line the waters of Bering Sea shoal gradually to the coast. There are no dangers in the open sea, unless the Pribilof Islands, St. Lawrence Island, St. Matthew Island, King Island, and Diomed Islands be considered as such. These, being volcanic in character and rocky, are generally bold-to, and in approaching them in thick weather the lead can not be depended upon at all times to keep clear of them. The coast of the mainland from the head of Bristol Bay to St. Michael, including Nunivak Island, is characterized by extensive banks, formed by deposits from the rivers, which extend many miles from shore, in some cases out of sight of land. Some of these shoals are believed to be quite steep-to on their seaward faces, making it unsafe to shoal the water to less than 10 fathoms when in their vicinity.

In this region, where fog and thick weather are the rule during the season of navigation, safety, when near the coast, depends on the use of the lead, which, on account of the generally regular bottom, will indicate the approach to danger. In general, all the shores of Bering Sea and the Arctic Ocean are shallow, and when coasting it should be observed as a rule to keep the lead going constantly, and when north of St. Michael never to shoal the water to less than 5 fathoms unless feeling the way in to the land. Between St. Michael and the head of Bristol Bay the water should not be shoaled to less than 10 fathoms under the same conditions.

There are few aids to navigation. All of the rocky islands and rocky cliffs of the mainland are frequented by thousands of birds, whose numbers, constant cries, and flight may serve to indicate the approach to shore at these places in thick weather.

The coast of Alaska from the head of Bristol Bay to Point Barrow and eastward has driftwood, which is brought down from the interior by the rivers and carried by the northerly currents of the sea. Good water can always be found in the vicinity of high land. Salmon are plentiful during the open season in all the streams as far north as Kotzebue Sound, and cod are plentiful in the vicinity of the passes and in Bristol Bay.

Ice.—Except in bays and sheltered places, the ice of Bering Sea is detached fields, floes, and cakes, which are continually kept in motion, breaking up, piling, and telescoping by the action of variable winds and currents. At no time is the sea one solid sheet of ice, and in the winter, while it is forming, it is more scattered than in the spring, when the northerly movement has begun and it packs closer together. The general southern limit of ice is from Bristol Bay to the vicinity of St. George Island, and thence about west-northwest to the Siberian shore. The southern edge is ragged and very much scattered, and continued northerly winds sometimes drive fields of it far southward. As a rule, no heavy ice will be encountered south of the Pribilof Islands, and the ice in their vicinity is likely to be nothing more than detached fields.

The ice conditions in Bristol Bay have so far received little notice. Reports have been received that the bay is usually free from heavy ice between the middle of May and June 10. In 1899 the steamer *Jeanie*, of 1,000 tons and a draft of 18 feet, reached Clark Point, in Nushagak River, on April 4, and was discharged on April 15. At this time the ice in the river above Fort Alexander remained solid, but two weeks afterwards it broke up and came down the river in large pieces, which would have endangered any vessel at anchor. In approaching the Nushagak River some ice was encountered about 75 miles from Cape Constantine, but not sufficient to seriously interfere with navigation. On May 10, 1896, a vessel bound for Bristol Bay was brought up by the ice, which extended from Port Moller to St. George Island, and she was not able to reach the Nushagak River until thirty days later. It is within reason to believe that some years Bristol Bay is open to navigation all winter, though the rivers and sheltered bays are closed.

In the spring, beginning with April, there is a general northward movement of the ice, the shores clearing ahead of the center of the sea; but it sometimes hangs in the bays and around the islands later than in the open sea. Seasons vary, the movement and position of the ice depending greatly on the direction of the winds. Generally, however, by June 1 the whole body of ice is well up with St. Lawrence Island, and a passage opens to its west side. The eastern side of the sea is likely to be obstructed a little later than the western side, and ice is often met between St. Lawrence Island and Nunivak Island in the early part of June. The breaking out of the rivers toward the latter part of May clears the shores, but the ice is likely to hold in Norton Sound several weeks later.

In general, for a vessel not fitted to encounter ice, Norton Sound is not navigable before the middle of June, often not before June 20 to 25, and has been known to be as late as July 10. On entering the sound about this time, strips of ice are often encountered after the sound can be said to be navigable. From the deck these may appear extensive and solid, but from aloft clear water may be seen beyond and through them. At the opening of navigation the ice is likely to be heaviest and to remain longest on the north shore, and, in general, it is the last of June before that part of the sound is altogether clear.

In the fall young ice begins to form on the rivers, and in the bays and sheltered places after October 1, and grows stronger and spreads according to the severity of the advancing season. Navigation is considered unsafe in Norton Sound after October 15.

Currents.—There has been no systematic study of the currents of Bering Sea, and the almost constant fogs prevent the navigator from adding much to our meager knowledge concerning them. It is said that in general the currents are greatly influenced by the tide and winds. The following observations apply to the open season, when the flow of the currents is not obstructed by ice:

Between Cape Cheerful and St. George Island the current is not believed to have any decided set or flow unless influenced by the wind. With a strong wind a current is likely to

set with it, but $\frac{1}{2}$ point allowance in a course will be sufficient to overcome any set that will be found in this vicinity due to this cause.

Between St. Matthew and Nunivak islands the set of the current is northward; with prevailing northeast winds it sets northwest, and with northwest and southwest winds, northeast. This northerly current continues and increases between St. Lawrence Island and the mainland, being stronger toward the mainland north of the mouth of the Yukon River, where it amounts to about 1 mile, except in the early summer, when, increased by the freshets in the Yukon, it may amount to 2 miles or more.* The current sets north across Norton Sound to Sledge Island and then follows the coast to Bering Strait. It is strongly marked between Sledge Island and Bering Strait.

In Bering Strait the current sets north, and when not influenced by wind its velocity is about 2 miles an hour. Protracted northerly gales which prevail in the autumn change its direction to the southward, but on the cessation of the wind it quickly sets north again. Strong southerly gales increase its velocity to 3 miles. The current is stronger east of the Diomed Islands than west of them.

A current sets strongly from Cape Newenham through Etolin Strait.

Tidal currents.—In the southern part of Bering Sea, inside the 100-fathom line, and through the various passes in the Aleutian Islands, the tidal current sets northward or northeastward during the rising tide, and southward or southwestward during the falling tide. In some of the passes it sometimes has a velocity of 9 miles an hour; when clear of the passes its maximum velocity is about $2\frac{1}{2}$ miles. At the Pribilof Islands, Nunivak, St. Matthew, and St. Lawrence islands the tidal currents have considerable velocity. The flood current sets eastward and northward and the ebb westward and southward. In Bristol Bay the tidal currents have great velocity. They have also considerable velocity at the Kuskokwim River and north to the mouth of the Yukon, especially in Etolin Strait and about Cape Vancouver.

Fog is most prevalent during spring, summer, and early fall, and it generally begins to clear about the middle of October. In summer fog is almost continuous, but few days are clear from morning to night, and the tops of the mountains can seldom be seen. At the surface of the water it is generally sufficiently clear to make out the shore at a distance of 3 or 4 miles, but at times it is so thick that nothing can be made out, and under such conditions strangers should not attempt to make the land. During the summer months the mist and fog are considered to be worse on the south side of the Aleutian Islands than on the north side in their immediate vicinity.

Weather.—The most striking feature about the weather in Bering Sea is its great uncertainty throughout the year. Good weather is rare and not lasting, and the winds can not be depended upon to remain long in one quarter. The late spring and summer are mild and very foggy, with frequent periods of light weather, comparatively few strong winds, and considerable rain. After September 1, gales become frequent and heavy, fogs gradually lessen, and toward the latter part of the month snow often accompanies the storms. During all the fall, gales are frequent, violent, and from almost any quarter.

During the fall and winter there are often periods of very low barometer (readings below 29.00 being common) accompanied by moderate to strong gales, with rain or snow. These gales, though sometimes very severe, are usually not so strong as would be expected by the fall of the barometer. After December and continuing into the spring there are often periods of moderate weather, and while severe gales occur, they are less frequent than in the fall. Strong winds or gales from any quarter always bring thick weather, rain, or snow. With easterly or southerly winds the rain is continuous, while with westerly or northerly winds the rain or snow occurs at intervals in squalls, and when the wind subsides the weather is likely to be clear.

Southeast gales, with falling barometer and rising temperature, are almost invariably preceded by an unusual clearness of the air; cirrus clouds are seen southwestward, which grad-

* A strong northeasterly current setting on the Yukon flats has been observed, amounting at times to $2\frac{1}{2}$ miles.

ually thicken and overspread the sky. The wind usually shifts to southwestward when the barometer ceases to fall, but it sometimes backs from southeast to northeast, and generally goes to northwest before subsiding. Upon abating, the gale is followed by light westerly winds and comparatively clear weather.

BRISTOL BAY.*

Bristol Bay may be said to include all that part of Bering Sea lying east of a line drawn from Cape Sarichef, Unimak Island, to the Kuskokwim River. Unimak Island and the Alaska Peninsula bound it on the south and east, and separate it from the Pacific Ocean. The Naknek River is at the head of deep-water navigation, while the bay itself terminates in the Kvichak River, a few miles northward. The region about the Nushagak River, Kulukak Bay, and the Kuskokwim forms its northwest boundary.

The shores are usually low and without distinctive features, but high mountain ranges and volcanic cones extend along the central parts of Unimak Island and the Alaska Peninsula. These rugged snow-covered mountains and lofty peaks would serve as unmistakable landmarks were they not obscured by the almost constant fogs which prevail in that region during the summer months. The shore and objects near the sea level are often seen beneath the fog when the higher lands are obscured, and, therefore, most of the available landmarks are found on or near the beach.

The winds and weather in Bristol Bay and the other parts of Bering Sea visited by the *Albatross* from the last of May to the 1st of September, 1890, may be summarized in a few words.

Southwest winds prevailed, but we had them frequently from southeast to northwest. It was boisterous weather nearly half the time, but seldom rough enough to interfere with our work. We had several summer gales of moderate force, but no severe storms. Fog and mist prevailed, and a clear day was the rare exception. The tidal currents were strongest in the vicinity of Unimak Pass and at the head of the bay; they were greatly affected, however, by the winds. The flood stream sets northward and slightly inshore along the coasts of Unimak Island and the peninsula, the ebb southward and offshore. The former was invariably the stronger, and probably found an outlet by sweeping past Cape Constantine in the direction of Cape Newenham. There has been no systematic study of the currents of Bering Sea, and the almost constant fogs prevent the navigator from adding much to our meager knowledge concerning them.

Reports have been received which indicate an easterly set, variable in velocity, along the northern side of Alaska Peninsula and in Bristol Bay.

COAST FROM UNIMAK PASS TO PORT MOLLER.

Cape Sarichef, Unimak Island, is described on page 11; it is low with detached rocks close inshore, around which strong tidal currents sweep. The land falls away eastward in a gentle curve, forming an open bay about 4 miles in depth between the cape and Cave Point, which lies 16 miles from the former. **Cave Point** is a vertical, rocky cliff, about 150 feet in height, and takes its name from a cave on its face, inhabited by sea birds, which in summer time hover about it in thousands, making it conspicuous in clear weather by their numbers, and in fogs by their constant cries. The snow-clad peak of **Pogromni Volcano**, rising to an altitude of 6,500 feet above the sea, forms a striking background to the low, monotonous coast.

Passing **Cape Mordvinof**, a low, bluff point about 8 miles from Cave Point, the coast falls away slightly for 6 miles, when it turns abruptly eastward for 5 miles, and then takes a northerly direction, forming **Urilia Bay**. This bay is open northward, but affords protection from all winds from southward of east or west. The approaches are clear, and the water shoals gradually to 6 fathoms, black sand, about $\frac{3}{4}$ mile from shore.

* From a reconnaissance by Lieut. Commander Z. L. Tanner, U. S. N., commanding U. S. S. *Albatross*, in 1890, and Commander Jefferson F. Moser, U. S. N., commanding U. S. S. *Albatross*, in 1900, with additions from other sources.

From Urilia Bay to Isanotski Strait the coast trends in a northeasterly direction, is very low, and has several rocky patches extending $\frac{1}{2}$ to 1 mile from shore, making navigation unsafe inside the 12-fathom line. The volcano of **Shishaldin** rises 9,387 feet about midway between the above points and 7 or 8 miles inland. Isanotski Strait is available only for vessels of the smallest class.

From the strait to **Cape Glazenap**, about 19 miles, the coast retains the same general direction and is very low until reaching the latter point, which is oval in form, about 150 feet in height, and has been called Round Point.

Izembek Bay covers a large area at high tide, but much of it is dry at low water. A small vessel may, however, find a secure harbor behind the cape. The channel follows close around the point, and has a depth of 10 to 12 feet on the bar.

Amak Island is of volcanic origin, about $2\frac{1}{2}$ miles in length, $1\frac{1}{2}$ miles in width, and 1,682 feet in height. It lies 11 miles northwest from Cape Glazenap. The beaches are mostly huge boulders and bluffs 30 to 150 feet high. The central peak is a dark-brown rock, bare, rugged, and precipitous. The southeast point is in latitude $55^{\circ} 25' 05.6''$ N. and longitude $163^{\circ} 07' 33.6''$ W. There is foul ground off the northwest end of the island, several rocks awash or under water, and Sealion Rock between 2 and 3 miles distant. The latter is several hundred yards in extent and about 150 feet high, its slopes being occupied by an extensive rookery of sea lions. A reef about $\frac{1}{4}$ mile long lies off the southeast end of Amak Island; about 250 yards of this reef shows bare. Lieut. S. P. Edmonds, R. C. S., reports that a fair lee and anchorage with hard bottom can be found on the southeast side of the island, and one not so good on the southwest side, but the foul south point of the island must be given a wide berth.

The **Kudiakof Islands** extend about 19 miles between Cape Glazenap and Moffet Point. They are but little above high water, and some of them are connected by narrow spits at low water.

From Moffet Point the low coast extends 15 miles to Gerstle Bay, then northward and eastward about 55 miles to Wolf Point, on the western side of the entrance to Port Moller.

The **Kudobin Islands** occupy the last 23 miles of this distance. They are very low, and it is difficult to distinguish them from the mainland, the only distinctive feature being a knob about 25 feet high on the east end of Kritskoi. The land between Herendeen Bay and Nelson Lagoon is very low.

PORT MOLLER AND HERENDEEN BAY.

Port Moller and Herendeen Bay were partially surveyed by the *Albatross* in 1890, but the chart should be used with caution until it is ascertained whether the extensive banks guarding the entrance are permanent or shifting.

To enter Port Moller from southward, pass Walrus Island in from 10 to 12 fathoms, and bring **Entrance Point**, the eastern point at the entrance to Point Moller, to bear 132° true (**ESE.** mag.). It will then be about 8 miles distant, and have the appearance of being the southern extremity of a high and bold headland, the first that approaches the coast between that point and Cape Glazenap. Stand in, keeping the point on the above bearing until within 2 or 3 miles, when it will show as a low spit backed by a cluster of hillocks, the high land before referred to being seen farther inland. Pass Entrance Point at a distance of 1 mile, steering about 173° true (**SSE. $\frac{3}{8}$ E.** mag.), and stand for **Harbor Point**, $4\frac{1}{2}$ miles from Entrance Point, passing it within $\frac{1}{4}$ mile, where anchorage may be found. The point is low.

A shoal makes off from Entrance Point about 346° true (**NW.** by **N.** mag.) between 3 and 4 miles, and vessels making for the harbor from northward are liable to run in behind it. Entrance Point should not be brought to bear southward of 155° true (**SE.** mag.) after having approached within 4 miles of it.

To enter Herendeen Bay, bring Entrance Point to bear 70° true (**NE. $\frac{1}{2}$ E.** mag.), 1 mile distant, and **Point Divide**, 228° true (**SSW. $\frac{1}{2}$ W.** mag.), $8\frac{3}{4}$ miles distant; then steer for the latter, keeping it on that bearing until $2\frac{1}{2}$ miles from it, when the course may be changed

to about 238° true (SW. $\frac{5}{8}$ S. mag.), passing in mid-channel between Point Divide and **Doe Point**, the southeast point of Deer Island. The least water is 4 fathoms at the entrance to the channel.

Having cleared Hague Channel, bring **Coal Bluff**, 5 miles southeastward from Point Divide, to bear 159° true (SE. $\frac{3}{8}$ S. mag.), and stand for it until Point Divide bears 4° true (N. by W. $\frac{3}{8}$ W. mag.), $1\frac{1}{2}$ miles distant and about 400 yards open of Doe Point; then steer 170° true (SSE. $\frac{5}{8}$ E. mag.), until **Eagle Rock**, 1 mile northward from Coal Bluff, is abeam, keeping the above points a little open to clear **Halftide Rock**, which lies $\frac{7}{8}$ mile 320° true (NW. by W. $\frac{3}{8}$ W. mag.) from Eagle Rock. Then steer 187° true (S. by E. $\frac{1}{8}$ E. mag.) until **Shingle Point**, 2 miles southward from Coal Bluff, is abeam, when a course may be laid for Mine Harbor, giving Bluff Point a berth of $\frac{1}{4}$ mile.

Mine Harbor is small but free from dangers, except Midway Reef, which extends $\frac{3}{8}$ mile from its eastern shore and shows at half tide. Anchor northwestward of Midway Reef in 12 to 15 fathoms, and if intending to remain any time it is advisable to moor. A reef extends 600 yards westward from Crow Point, the south point of Mine Harbor. Crow Reef, bare at low water, lies $\frac{7}{8}$ mile westward of Crow Point and $\frac{1}{2}$ mile southward of Bluff Point.

Tides.—It is high water in Mine Harbor, full and change, at 8h. 0m., rise 15 feet, and it occurs at Entrance Point about 2 hours earlier, with a rise of 10 to 12 feet.

Hague Channel is 1 mile in width at its northern entrance, and is contracted to less than $\frac{1}{2}$ mile between Point Divide and Doe Point. The tidal currents are very strong, and near high water they sweep across the narrow channel and over the flats, making it impossible to steer a compass course. They are more regular near low tide, which is the best time to make the passage, as the channel is indicated by the flats showing above water on either hand.

Johnston Channel, Herendeen Bay, has 7 to 15 fathoms, but is very narrow with steep sides. It is difficult to find, but once in, the navigation is comparatively simple, as the tidal currents follow the general direction of deep water. The width of the channel at the northern entrance, $\frac{7}{8}$ mile south of Point Divide, is $\frac{1}{4}$ mile, with little variation until near the southern extremity, where it contracts to 250 yards. Having cleared the channel and entered the upper bay, there is ample room and depth of water in every direction, Crow Reef, off the south point of Mine Harbor, being the only outlying danger.

Anchorages may be found anywhere between Walrus Island and Entrance Point in case of fog, and a vessel may anchor in Hague Channel, but the tidal currents are strong. There are fairly good anchorages under the north side of Point Divide and Doe Point, where, near the bank, a vessel will be out of the strength of the current. The *Albatross* anchored in mid-channel, 1 mile inside of the above points, at the time of spring tides, and the flood came in with a bore between 2 and 3 feet in height, the patent log registering a 9-knot current for some time, with a swell which occasionally splashed into the scuppers. There is a fair anchorage off the northern entrance to Johnston Channel, and an excellent one at its southern extremity, off Marble Point, just north of Shingle Point, or, in fact, almost anywhere in the upper bay. The last quarter of the flood tide is the best time to pass through this channel.

High land rises at the base of Harbor Point, and extends northward and eastward near the middle of the peninsula. Point Divide is 50 feet in height, and mountain ranges rise a few miles back. The coal measures are found between Mine Harbor and the head of Port Moller. Doe Point is 40 feet in height, while the rest of Deer Island and the mainland south and west of it is generally lower. The southern shores of Herendeen Bay are mountainous, with intervening valleys, the whole face of the country being covered with rank grass and wild flowers during the summer months; but there is no timber, except occasional small poplars, alder bushes, and willows. Fresh winds, with fog and mist, blow across the low divides from the Pacific, obscuring the sun and greatly increasing the rainfall in Port Moller and vicinity.

There are no large fresh-water streams entering the bay, which probably accounts for the absence of Eskimos.

COAST FROM PORT MOLLER TO KUSKOKWIM RIVER.

The coast is low for 19 miles between Entrance Point and **Cape Kutuzof**, which rises in a rounded bluff to an elevation of 150 feet.

Cape Seniavin, 11 miles northward and eastward, is a rocky point 75 feet high. Passing it, the low, monotonous beach continues to the Seal Islands, the only exception being a cluster of small hillocks near the beach, 12 miles from Cape Seniavin.

The **Seal Islands** are several small islets, but little above high water, strung along near the coast for about 10 miles; thence to Strogonof Point the land continues very low.

Port Heiden is said to be a good harbor, but it was not examined. The approach to the port will be recognized by high, bold headlands, which rise from its northern shore. **Chistiakof Island**, low and crescent-shaped, forms the seaward side of the harbor, the channel lying between its northern extremity and a reef which makes westward about 3 miles from the land about 2 miles northward from the island. An extensive reef is also reported to extend about $1\frac{1}{2}$ miles off the northwest side of Chistiakof Island. It is reported that there is a rise and fall of 18 feet on the largest spring tides, and about 12 to 14 feet on ordinary tides.

Until a proper survey of the Bristol Bay region has been made it must be regarded by mariners as a dangerous locality to navigate; it is only by the greatest vigilance and constant use of the lead that disaster can be avoided upon approaching the land. This is particularly true of the northeast arms and approaches which receive the waters of the great salmon streams on which all the Bering Sea canneries are located.

These rivers are the Igushik, Wood, and Nushagak, emptying into Nushagak Bay; the Kvichak, Alagnak, Naknek, and Ugaguk, which empty into Kvichak Bay; and the Ugashik, next southward of the Ugaguk. These rivers are large and discharge a great quantity of water into wide indentations, locally still retaining the name of rivers, which open on the arms of the great bay. The banks of the rivers are frequently marshy, generally muddy, and the discolored water is charged with a large amount of sediment which is deposited, forming the dangers to be encountered.

On account of the funnel-shaped configuration of the bays and river entrances, the tidal currents run with great force, having a velocity at times of at least 6 miles, and the tides have a rise and fall of 18 to 24 feet; vast areas of shoals are uncovered at low water, leaving only pools and shallows, and generally narrow channels between. Navigation in the arms and approaches is only successfully accomplished at or near high water, even by those thoroughly acquainted with the channels.

From Port Heiden the same low coast extends to Cape Menshikof in nearly a direct line, the highland of Port Heiden gradually receding from the coast. A shoal inlet or river entrance lies about 10 miles southward of Cape Menshikof. It has sometimes been mistaken for the Ugashik River. **Cape Menshikof** is a high bluff, extending some distance along shore, with hilly country back of it.

Ugashik River is large and empties into the wide indentation between capes Menshikof and Greig, the distance between the capes being about 15 miles. The capes can be approached from westward as close as about 2 miles. The coast between the capes including the river valley appears low. Smóky Point, a bluff on the north side at the entrance, is about 7 miles southward of Cape Greig. Here the river is about 4 miles wide at high water. The indentation between the capes, and the mouth of the river are filled with shoals. There is a channel with about 10 feet at low water, which is buoyed during the season for the use of the cannery vessels, but a stranger could not follow it with safety.

There is communication by telephone among some of the canneries at the head of Bristol Bay from Ugashik River to Nushagak River.

Cape Greig is a prominent, brownish bluff, with a few yellow vertical stripes, 243 feet high, extending several miles along shore. It appears to be the seaward end of a low ridge with low land on each side. This and a peculiar-notched mountain some distance inland,

are good marks. The low coast continues from the cape to the Ugaguk River, and thence to the Naknek River, with hardly a distinguishing feature, except **Johnston Hill**, a solitary elevation, 5 miles from the beach and about 9 miles southward from the mouth of the Naknek.

Ugaguk River empties into the outer limit of Kvichak Bay about 30 miles north of Cape Greig, and has Cape Chicagof for its northern entrance point. It is a large river, about 2 miles in width at the cannery, and is the outlet of Lake Becharof. It flows in a general westerly direction for about 50 miles. Tide water is said to extend about 25 miles up the river; very little is known of the locality.

The lower part of the river is a wide bay, contracted at the mouth, and, like other rivers of this district, at low water a large part of the bed is exposed in shoals and banks with narrow channels winding through them. At the entrance shoal water extends several miles offshore, and the small cannery steamers enter only from half to full tide. The channel into this river is wider and deeper than in Naknek and Kvichak, and, if it were properly buoyed, vessels of moderate draft could enter at high water, but there is no swinging room inside. The cannery transporting vessel, a bark of 554 tons, was carried in at high water and moored head and stern alongside the low-water bank.

Naknek River may be considered as the head of deep-water navigation in Bristol Bay. It enters Kvichak Bay on the eastern side, about 25 miles southward of Kogiung. The river has its source in the large lake of the same name as the river, on which two villages are located. The river is large and about 60 miles in length.

It is said that tide water extends about 25 miles from the mouth, where the river is about $\frac{1}{2}$ mile in width, and that at the mouth the extreme rise and fall of spring tides is over 20 feet.

Shoals and banks, many of which uncover at low water, fill the lower course of the river and extend 3 or 4 miles off the mouth, then trend around northward and join the body of the banks that fill the upper end of Kvichak Bay. At low water the channel between the banks and flats is very shallow; cannery steamers, drawing but 7 feet of water, await half tide before entering. Navigation is done on the rising tide or at high water. High water, full and change, 1h. 5m.; rise 23 feet.

The mouth of the river is about 3 miles wide between the headlands, which are bluffs about 100 feet high; within the entrance the banks converge quite rapidly, and about 4 miles from the mouth the river is about $\frac{3}{4}$ mile wide.

The *Albatross* anchored in 6 fathoms about 6 miles 247° true (S W. mag.) from Cape Suworof, the water shoaling rapidly to 3 fathoms toward the mouth of the Kvichak River.

Kvichak Bay.—The large arm at the head of Bristol Bay, extending northeast and bounded on the south by a line from the south entrance point of Ugaguk River to Etolin Point, has been designated as Kvichak Bay. The upper part of the bay is very shoal, and, as the current is strong, it can be safely navigated only by small vessels built to resist the shock of repeated grounding. It is said that the banks from the Etolin side project halfway across the bay, and, with those from the peninsula side, confine the channel to a comparatively narrow limit; a seagoing vessel, however, under skillful guidance and with local knowledge, may reach a point a few miles below the mouth of the Naknek River, which is about 30 miles below the head of the bay; but some cannery men consider the risk too great to carry their transport vessels to this point and leave them there for the season.

Above the mouth of the Naknek River the shoals begin to extend across the channel, and, as a point higher up is reached, the whole bay at low water is filled with uncovered banks, having shallow, narrow channels winding through them.

At the head of the bay is the mouth of the Kvichak River, which is the outlet to the great lakes, Iliamna and Clark, lying on the western side of the mountain system bordering Cook Inlet.

NUSHAGAK RIVER

is important as the location of a trading station and of a number of large canneries. Owing to swift currents and extensive shoals, it may be classed among the most intricate pieces of navigation in Bristol Bay. A 6-knot current is frequently encountered, hence the shifting of

banks and shoals must be expected, and the necessity for the constant use of the hand lead becomes too obvious to require remark; indeed the warning from a lead on each side will leave but a small margin of safety at times.

From a point about 3 miles westward of Cape Greig the *Albatross* kept along the coast at a distance of 6 or 8 miles for 25 miles, and then steered a course to clear the shoals off Cape Constantine. Acorn Peak was made and mistaken for Nichols Hills, and, before the latter were made out, the vessel was inside the shoals as indicated on Coast Survey chart 8800, and Cape Constantine was in sight from aloft. After bringing Nichols Hills on a bearing 314° true (WNW. mag.) the course was laid for them and an anchorage made in 8 fathoms at low water, with Point Protection bearing 224° true (SSW. mag.), distant $2\frac{1}{2}$ miles. This anchorage is not considered a good one and, according to the cannery people, should not be selected. This will be referred to later.

It has been advised that a vessel bound for the Nushagak should make Cape Greig, which is high and easily recognized, and, from this position, take her departure and shape the course for the entrance, favoring the Etolin side in preference to the Cape Constantine side, and using the lead constantly in approaching these shoals. A vessel should arrive in the entrance to the bay midway between Point Protection and Point Etolin, and, from this position, a course 337° true (NW. mag.) for a distance of 5 miles will carry outside the lower bar, where a stranger must anchor and communicate for a pilot. Judgment must be used in making allowance for tidal currents, and, it is needless to say, the right arm of the navigator in these regions is the lead.

The following notes made on leaving the Nushagak may be of service: A vessel bound out should leave the upper anchorage two hours before high water, so as to have the best water on the bars. The *Albatross* left the anchorage at the upper cannery at high water, and followed the western shore at a distance of 300 to 400 yards to the lower cannery on the same side (Bristol Bay Cannery Company). After rounding the point below this cannery, the distance from shore was increased to avoid a spit making out from the first valley beyond the point, on which the bark *Wildwood* was lost. Having passed the spit, the western shore was kept well on board, making allowance for the beach that uncovers at low water. A short distance above Coffee Point the *Albatross* laid a course 173° true (SSE. $\frac{5}{8}$ E. mag.) for 2.3 miles, then 151° true (SE. $\frac{1}{2}$ E. mag.) for 1.1 miles, which carried over what is known as "the cross-over" and to Clark Point. The eastern shore was then followed at a distance of $\frac{1}{4}$ to $\frac{1}{2}$ mile, and on arriving off Ekuk she hauled sharp across the river bar on a course 247° true (SW. mag.), which course was kept until the cannery at Clark Point came on with the second depression in the distant blue ridge northward, and the right tangent of the ridge on the south side of the Igushik River came on with the left tangent of the first high mountain of the ridge beyond the lowland. The course was then changed to 163° true (SE. $\frac{1}{2}$ S. mag.), and after running about $3\frac{1}{2}$ miles the outer bar was crossed.

The *Albatross* made the shoal water of the outer bar on the following bearings: Clark Point, 11° true (N. by W. mag.); Nichols Hills, 213° true (S. by W. mag.); right tangent bluff south of the Igushik River, 299° true (W. $\frac{5}{8}$ N. mag.). From the outer bar the cannery vessels are said to steer 168° true (SE. by S. mag.) to sea. The *Albatross*, with an ebb tide, steered 157° true (SE. mag.) until clear of all shoals and then laid her sea course.

Nichols Hills, as indicated on Coast Survey chart 8800 and others, is very misleading. There are no high, isolated hills in the vicinity; a line of high bluffs from Igushik River border this shore to the southward, fringed by a narrow belt of marsh, and, about 4 miles northwest from Point Protection, these bluffs are broken on top into mounds which are the Nichols Hills, locally known as the Knolls.

Under average conditions they do not form a leading mark, as stated, for guidance from seaward, as they rise but little above the bluff line, and it is not believed they can be made out by a stranger in time to avoid the dangers off Cape Constantine.

About 2 miles northwest from Point Protection the bluffs referred to break away westward, and are lost on approaching the beach 2 miles south from the same point. **Point Pro-**

tection and its vicinity for several miles is low and marshy, with an occasional low mound and hillock.

The coast between Cape Constantine and Point Protection is generally low, and the interior is rolling, broken into high mounds, ponds, and marshes.

Very little is known of the extent of the shoals off Cape Constantine; it is probable that the bottom is much broken and lumpy off the whole entrance to the bay. The *Albatross*, two hours before low water, had several soundings of 5 fathoms well outside of the bay in what is considered to be the best water.

The A. P. A. cannery ship *Sterling*, with the spring outfit for Kogiung on board, was lost on the shoals about 5 miles southward of Cape Constantine. At the point where the vessel struck, Cape Constantine and Point Protection are in line.

At Point Etolin, there is a line of low bluffs which, at three points, show a bald, yellowish face, the highest to the westward. The land in this vicinity is generally low. It is said the shoal off Point Etolin does not extend as far offshore as indicated on Coast Survey chart 8800.

The cannery tenders, in running from the Nushagak to the Kvichak, usually round Point Etolin by the lead, keeping in 3 or 4 fathoms of water, which they expect to find about 4 miles from the shore.

Clark Point is 18 miles above Point Protection, the usual anchorage being $\frac{1}{2}$ mile to 1 mile above it. High water, full and change, 0h. 53m.; approximate rise, 24 feet.

Ekuk, an Eskimo village, is on the bluff, nearly 3 miles below Clark Point.

Clark Point is a bluff 200 feet in height, beginning below Ekuk and extending 2 or 3 miles up the river, and thence to Nushagak. It varies from 100 to 150 feet in height. The west side of the river is generally lower, but from Coffee Point, 4 miles northwest from Clark Point, northward the bluffs rise from 50 to 200 feet.

Cape Constantine, the southern extremity of land at the entrance to the Nushagak, is very low, and shoals extend 10 or 12 miles southward and eastward, making its approach in thick weather very dangerous. There is said to be a channel between the cape and the first shoal, but the report requires verification. The coast increases in height westward of the cape, the headlands in Kulukak and Togiak bays reaching an altitude of 500 feet or more.

The **Walrus Islands** are three islands and three rocks, all above water, extending 16 miles east and west and about 6 miles north and south.

Round Island, the easternmost of the group, is nearly 2 miles long, $\frac{3}{4}$ mile wide, and about 800 feet high, its west end being in latitude $58^{\circ} 36' 09''$ N., longitude $159^{\circ} 57' 51.7''$ W.

Crooked Island is between 4 and 5 miles in length and 2 miles in greatest width. The eastern part is rather low, but toward the western extremity the elevation is nearly equal to that of Round Island. There is quite a large bay on the northeast side, but it was not examined.

High Island, the westernmost of the group, is 4 miles in length, about 1 mile in width, and 900 feet or more in height.

The Twins are two isolated rocks 4 miles southward of Crooked Island, the larger 300 and the smaller 100 feet in height.

Black Rock, about 150 feet high, lies 1 mile northward of the south end of Crooked Island.

No other outlying dangers were seen in passing between the islands and the mainland. From 6 to 10 fathoms were found abreast the group, the depth gradually decreasing to 3 fathoms off the north end of Hagemeister Island. The course was near the shore, however, and more water would doubtless have been found in mid-channel.

Hagemeister Island lies 9 miles west of High Island, and is 14 miles in length and 8 in width. It is mountainous except for about 5 miles at the north end. Shoals surround the island and extend eastward 20 to 25 miles, including the area between Hagemeister and the Walrus Group.

Hagemeister Strait is about 16 miles in length and lies between the island of that name and the mainland. It is 3 to 4 miles wide, but shingle spits contract it in two places to less

than 2 miles. The least water was $4\frac{1}{2}$ fathoms. Good anchorage was found under Tongue Point, the shingle spit making out from the mainland about midway of the channel. From the above anchorage the *Albatross* stood directly to sea, passing within a mile of the southwestern extremity of Hagemeister Island; thence 206° true (S. $\frac{1}{2}$ W. mag.), shoaling the water to 3 fathoms 7 miles from the island. Greater depths might possibly be found by taking a more westerly course. It is reported that there is anchorage under the spits at both ends of Hagemeister Island. The tidal currents are very strong through the channel. The vessel was visited by a number of Eskimos while at anchor under Tongue Point.

Cape Peirce is of moderate height and symmetrical form. Depths of 10 fathoms are found 2 miles southward of the cape, and good anchorage in 10 fathoms of water is found inside Shaiak Islet (lying just eastward of the cape).

Cape Newenham is a high, bold, headland, with sharp peaks and rugged lines. In 1899 the U. S. S. *Corwin* passed within 2 miles westward of Cape Newenham and carried 4 to 5 fathoms of water. While following the land at a distance of 2 miles, and keeping out of the indentations between Cape Newenham and Goodnews Bay, the depths were $3\frac{1}{2}$ to 4 fathoms until within 2 miles of the entrance of the bay, where the water shoals abruptly. The *Albatross* found anchorage under Cape Newenham near Seal Rock during a southerly gale, and laid it out very comfortably, notwithstanding swift currents and heavy tide rips.

Chagvan (Portage) Bay, lying about 16 miles northeastward of Cape Newenham, is a good anchorage for small craft.

Goodnews Bay, lying about 26 miles northward of Cape Newenham, has shoals extending several miles off the entrance, through which there is a channel with depths of about 3 to 4 fathoms leading into the entrance, which is about 1 mile wide. The bay is shallow in places, but depths of 3 to 8 fathoms will be found in channels between the shoals. **Baluka Hill**, a high and conspicuous hill on the north shore of Goodnews Bay, inside the entrance, is a useful landmark for entering. Giving Cape Newenham a berth of 3 to 4 miles, head up for Baluka Hill, about 31° true (N. by E. mag.), which should lead to the entrance of the channel through the shoal off the entrance to Goodnews Bay, and should carry a least depth of about 3 fathoms.

Carter is a settlement on an open bay about 55 miles northward of Cape Newenham; a depth of about 2 fathoms can be taken around the northern end of a grassy island to abreast the settlement.

Cripple Creek empties into a broad, open bight about 12 miles northward of Carter.

The **Kuskokwim River** is much dreaded by navigators on account of its extensive shoals, strong currents, etc. The *Albatross* ascended it between 35 and 40 miles without difficulty or delay, but encountered extensive shoals on her return. Thick weather and the lack of time prevented an extended examination. The shoals commenced about 9 miles 268° true (WS W. mag.) from Goodnews Bay and extended in a westerly direction for 10 miles or more. There is a channel between the shoal and the land about 4 miles wide, having a depth of 5 fathoms. From a point 5 miles 268° true (WS W. mag.) from the west head of Goodnews Bay we stood directly for Cape Newenham, the least depth being 4 fathoms. Great quantities of fresh water are borne down the Kuskokwim by the rapid currents, and, while there have been no surveys by which changes can be noted, there seems no reasonable doubt that great alterations have taken place since Cook ascended the river in the last century.

PRIBILOF ISLANDS.

This group consists of St. Paul, St. George, Otter, and Walrus islands. The two latter are small and uninhabited. St. Paul and St. George are important as containing the largest and most numerous seal rookeries of the world. These two islands are each in charge of a United States Government agent, and are at present under lease to the North American Commercial Company. Excepting vessels of the United States Government and those in the employ of the company, all vessels are forbidden landing on these islands. There are no harbors about the islands, and the anchorages are only available with the wind off the land. Because of

the uncertain and shifting nature of the wind in this locality, vessels should always anchor with a view of getting under way quickly if necessary.

Fogs are especially thick and prevalent in this vicinity in the summer, and navigation is attended with difficulty and danger.

These islands are at about the southern limit of the ice in Bering Sea. Detached fields of ice will generally be found in their vicinity from February to May.

ST. GEORGE ISLAND

consists mainly of high volcanic hills and ridges, and its entire coast is a precipitous cliff except for a few miles on the north side and short intervals at Garden Cove and Zapadni Bay. The east and west extremities of the island, Tolstoi and Dalnoi points, are bold promontories.

High Bluff, on the north side of the island, 1,012 feet high, is a prominent landmark, and is visible from St. Paul Island, a distance of nearly 40 miles, on a clear day. There are no harbors, but vessels anchor at North Anchorage, Garden Cove, and Zapadni Bay, according to the direction of the wind; the anchorages are poor except with the wind directly off the land. At a distance generally not greater than 2 miles from the island the depth of the water is but little less than the surrounding sea, and in thick weather it is not safe to depend upon soundings for picking up the land unless sure of the position. Vessels should not approach the island in less than 12 fathoms of water. There are no outlying dangers except the small reefs at Zapadni Bay and at North Anchorage. It is reported that vessels have found breakers, in very heavy weather, about 9 miles east of Tolstoi Point.

The anchorage in **Zapadni Bay**, on the southwest side of the island, in 10 fathoms of water, affords shelter with winds from east-northeast to north-northwest. The landing is on the open sand beach, and can usually be made with northerly winds. A reef extends about $\frac{1}{4}$ mile offshore southward of the anchorage.

With northerly winds, a landing may sometimes be made at **Garden Cove**, on the sand beach. The anchorage affords good shelter from northwesterly winds, but with the exception of a small area the bottom is rocky.

At **North Anchorage** there are two houses on the beach, with a road back of them leading up the hill to the village. In approaching, get these two houses open and steer for them. Anchor in not less than 10 fathoms. A flag is shown from the flagstaff when landing is possible. The landing westward of the houses is a cutting in the rocks for small boats to enter at high or medium tides. It is somewhat protected by a ledge of rocks north of it, and by kelp, which tends to reduce the breakers. At East Landing, just northeast of the village, is a similar boat landing, but better protected from a westerly swell. A ledge of rocks awash lies a short distance off this landing. If desired, a boat will come out to vessels at anchor when landing is practicable.

Tidal currents.—The current sets eastward during the rising tide and westward during the falling tide, with a maximum velocity of $2\frac{1}{2}$ miles. With opposing wind and current, tide rips occur off Tolstoi and Dalnoi points. These rips are not heavy enough to be of any moment, except that to strangers they may appear to be breakers. The water off both points is deep, and they can be passed close-to with safety.

OTTER ISLAND

has an abrupt bluff at its southwest end, 288 feet high, slopes gradually to the north and rises again in a crater, 150 feet high, at its extreme east end. Foul ground, marked by kelp, extends about $\frac{3}{4}$ mile from the island on its south, southwest, and north sides. The north side, from Crater Point to Northwest Reef, is clear of dangers. Probably the best anchorage near the island is in $9\frac{1}{2}$ fathoms, black sand and broken shells, with the northeast extremity of Crater Point bearing 185° true (*S. by E. mag.*), distant $\frac{1}{2}$ mile. This island must be approached with great caution in thick weather, and at all times keep out of kelp. Between Otter Island and Reef Point, St. Paul Island, the tidal currents are strong, and with heavy winds dangerous tide rips occur, especially on the ebb.

WALRUS ISLAND

is low, about 15 or 20 feet above the water, level on top, and composed of irregular masses of volcanic rock. It is about $\frac{3}{8}$ mile long and $\frac{1}{8}$ mile wide. Anchorage can be had on either side of it, $\frac{1}{4}$ to $\frac{1}{2}$ mile offshore, in 10 to 15 fathoms. Landing can be made with smooth water, the best place for this purpose being in a small cove at the southwest corner. The island is a bad place to make in a fog.

Parts of Otter and Walrus islands are covered with sea birds in the breeding season, and at the proper time a plentiful supply of eggs may be obtained.

ST. PAUL ISLAND.

The west and southwest parts of St. Paul Island are high and mountainous, with precipitous cliffs at the coast. The rest of the island is a comparatively low, rolling plateau, with a number of extinct volcanic peaks scattered over its surface. Bogoslof, 590 feet high, a conical crater near the center of the island, and Polovina, a double-peaked hill, 470 feet high, near its east end, are conspicuous, and are the best landmarks in clear weather when coming from southward. From this hill the island stretches away in a low, narrow neck to Hutchinson Hill, 100 feet high, on Northeast Point. West of Lukanin Bay the coast of the south side of the island is rocky, with bluffs at the points. The shore of the rest of the island is generally a sand beach, with rocks in the vicinity of the seal rookeries.

Dangers.—Kelp-marked reefs extend about $\frac{3}{8}$ mile southeastward from the two low points lying $\frac{5}{8}$ mile and $1\frac{1}{8}$ miles southward of **Northeast Point**. A dangerous ledge, marked by kelp, lies 1 mile 355° true (*N. by W. $\frac{7}{8}$ W. mag.*) from Hutchinson Hill. It is about $\frac{1}{4}$ mile in diameter, and its least depth is found on two rocks with 3 fathoms over them. With a moderate swell the sea breaks over these rocks and for a short distance off Northeast Point. Depths of 8 to 10 fathoms can be carried between the ledge and Hutchinson Hill by keeping the shore aboard distant $\frac{3}{8}$ to $\frac{1}{2}$ mile.

The north coast from west of Hutchinson Hill to Southwest Point is free of dangers, no reefs or rocks until within $\frac{1}{2}$ mile of the land, except off North Hill; but the bottom is uneven and rocky and the anchorage not generally good.

A rocky patch, with 7 fathoms water on it and 9 to 13 fathoms around, lies with Hutchinson Hill bearing 80° true (*NE. by E. $\frac{3}{4}$ E. mag.*), distant $3\frac{1}{8}$ miles. There may be less water on the shoal, as the locality was not fully examined.

Off **North Hill** a shoal extends about $\frac{1}{4}$ mile northward, the depths gradually increasing to 4 and $6\frac{1}{2}$ fathoms at 1 mile from the coast.

A spot with 5 fathoms over it is reported 8 miles 272° true (*WS W. $\frac{3}{4}$ W. mag.*) from the west end of St. Paul Island. Kelp has been noticed in this vicinity.

Breakers extend $\frac{1}{2}$ mile or more off **Southwest Point**.

A dangerous ledge, usually marked by breakers, extends $\frac{1}{2}$ mile southwestward and southward from **Reef Point**, the south point of the island.

A reef extends about $\frac{1}{4}$ mile off Tonki Point, the northeastern point of Lukanin Bay.

Anchorage.—The usual anchorage at this island is off the west side of Reef Point, and there is also an anchorage on the east side, off Black Bluffs. From the anchorage on the west side the village is hidden, but there is a flagstaff on the top of the hill overlooking the bay; from the Black Bluffs anchorage the village is in full view, and there is another flagstaff, the lower of the two, on this side. If a vessel is seen approaching, the United States ensign is hoisted on the flagstaff on the side on which she ought to anchor, and the ensign is kept flying if landing is safe, but hauled down if it is not safe.

Vessels should not attempt to ride out a gale at anchor near the islands, unless to leeward and well sheltered. The surf is apt to make quickly and is dangerous on the weather side of the island.

Landing.—In Village Cove, the landing place on the west side of Reef Point, the landing is just northward of the bluff point where the flag is hoisted; a bar extends across the

entrance, on which the sea breaks unexpectedly, and is often dangerous. Boats going in, after passing north of the point, must keep close in to the small point just outside the wharf. At low water boats can not land at the wharf.

The landing on the east side is a small cutting in the rocks, close to a salt house; with westerly winds and high water, landing here is easy.

A landing can sometimes be made at the head of the cove on the south side of Lukanin Bay, when impracticable at Black Bluffs or Village Cove.

Village.—The village is a number of small, wooden houses, painted white, with dark roofs, a church, also several large buildings for the Government Agent and the officers of the North American Commercial Company (which in 1890 obtained a lease of the Pribilof Islands for 20 years). There are about 250 inhabitants.

Tides.—The mean rise and fall at St. Paul Island is 2.1 feet. Around St. Paul Island the flood tidal currents sets eastward and the ebb westward, following the trend of the shore. The greatest velocity occurs at Northeast Point and between Reef Point and Otter Island, and is 1 to 2 miles, but with continued strong winds from one direction it may be increased to 3 miles. There are heavy rips around Northeast and Southwest points, also between Reef Point and Otter Island where they are worst on the ebb. The tides and tidal currents are greatly influenced by the winds.

NUNIVAK ISLAND

is rarely approached by vessels. For a distance of 10 miles about the island, especially on its east and north sides, the bottom is reported very uneven, consisting of ridges with deeper water between. The island should therefore be approached with caution. From westward it presents gentle slopes, terminating seaward in reddish cliffs 150 to 462 feet high. The highest point of the western part of the island is 830 feet, which is found 10 miles eastward from Cape Mohican. Near the center there are some mountains of moderate height that rise with a gentle slope. Except some hills, the eastern end of the island is low. In clear weather the island can generally be made out at a distance of 30 miles from any direction.

In 1899 the U. S. S. *Corwin* cruised completely around Nunivak Island, following the shore and outlying islands at a distance of about 2 miles, and found general depths of 7 to 10 fathoms. The coast is generally abrupt and rocky, with numerous bights in which anchorage was found with $3\frac{1}{2}$ to 7 fathoms of water.

Cape Mohican, the western point of the island, is in latitude $60^{\circ} 12' 45''$ N., longitude $167^{\circ} 27'$ W., as determined by the Coast and Geodetic Survey in 1902, and is a narrow promontory about 2 miles long. The point of the cape is a cliff 266 feet high, from which it falls eastward to a height of 150 feet in a distance of 2 miles, and then rises by a gentle slope to the higher land of the island.

A dangerous ledge extends off Cape Mohican, probably 1 mile, though the distance is uncertain. Between 1 and $14\frac{1}{2}$ miles westward of the cape the soundings show a somewhat irregular bottom with depths of 13 to over 23 fathoms. A shoal with $4\frac{1}{2}$ fathoms over it is reported about 14 miles 271° true ($WSW. \frac{1}{2} W.$ mag.) from Cape Mohican. It is reported that a reef exists $1\frac{1}{2}$ miles north of Cape Mohican, and extends eastward about 3 miles; this reef was observed to be breaking along its entire length with a smooth sea. A shoal with 3 fathoms and less is reported 5 miles 349° true ($NNW. \frac{1}{2} W.$ mag.) from Cape Mohican.

A shoal with 9 feet over it is shown on the charts about 10 miles 46° true ($NNE. \frac{1}{2} E.$ mag.) from Cape Mohican. A line of soundings with 12 to 13 fathoms was run by the *Manning* about 2 miles inside (southward) of this position, and another by the *Patterson* with 14 to 16 fathoms $13\frac{1}{4}$ miles westward of it.

From Cape Mohican the southwest coast extends with a slight curve in a southeasterly direction for $9\frac{1}{2}$ miles to what may be called the southwest cape of the island. This stretch of coast is impassable cliffs 150 to 462 feet high, and there is no boat landing. The 6-fathom curve is about $1\frac{1}{4}$ miles offshore, and there are no known outlying dangers. An observation of the tidal current gave a maximum velocity of 1.2 miles on both flood and ebb; the flood sets northwestward and ebbs southeastward alongshore.

The southwest cape of the island is cliffs 100 to 150 feet high, the summit of which is gentle slopes of tundra. The coast here changes direction gradually eastward for 2 miles to a small cove, which is the first boat landing southeastward of Cape Mohican. The best landing place is on the sandy beach in front of a small native village. Fresh water can be obtained from the stream just east of the village, which, at low water, is fresh to its outlet. A temporary anchorage may be made about $\frac{3}{4}$ mile off the entrance to the cove, in 7 to 8 fathoms.

From the southwest cape of the island the coast has a general 122° true (*ESE. $\frac{3}{4}$ E. mag.*) direction for about $21\frac{1}{2}$ miles, and then changes direction to about 108° true (*E. mag.*) to Cape Mendenhall, the southern point of the island. In the first 22 miles from the southwest cape, the few soundings taken show deep water fairly close to the shore, and following the coast at a distance of 2 miles is apparently safe. But at a distance of 5 miles or more offshore there is an extensive bank on which soundings of $4\frac{3}{4}$ to 6 fathoms have been made. The bank is included approximately between latitude $59^{\circ} 46'$ and $59^{\circ} 53' N.$, and longitude $166^{\circ} 50'$ and $167^{\circ} 20' W.$

Cape Mendenhall, the southern point, is about 200 feet high, with a steep bluff on its east side, which extends halfway to the bottom of the bight between this cape and Cape Corwin. Breakers are said to exist 6 or 7 miles from Cape Mendenhall. In 1900 the *Manning* rounded the cape at a distance of about $5\frac{1}{2}$ miles in depths of 13 to 14 fathoms.

Cape Corwin, the eastern point, is low, with a rocky shore north of it; the cape is definitely marked by the twin peaks of a mountain, which can be seen 25 miles in clear weather. The *Manning* passed about 2 miles eastward of the cape in depths of 10 to 11 fathoms.

The three following anchorages are from an oral description by Capt. J. L. Fisher, who anchored with a stern-wheel steamboat in each of them in July, 1898:

The first is in the bight between Cape Mendenhall and Cape Corwin; close inshore, in 3 fathoms, with sand and gravel bottom. Fresh water can be obtained at this anchorage.

The second is in the cove on the north side of **Cape Corwin**; it is very rocky and a poor anchorage. Fresh water can be obtained here; it is discolored and of poor quality.

The third is on the north side of, and about 12 miles eastward of, the north end of the island. It is in a cove open eastward, but deep enough to afford shelter from northerly and southerly winds. Captain Fisher considers this the best anchorage on the east side of the island. Fresh water can be obtained at this place. In 1900 the *Manning* cruised in this locality and reports that the anchorage on the north side of Cape *Manning* has not the appearance of a good harbor at low water, and that the rise and fall of tides is 12 feet.

From Cape Etolin the shore trends in a general 120° true (*E. by S. mag.*) direction about 20 miles to a point called **Cape Manning**, and from the latter cape to Cape Corwin the direction is 176° true (*SSE. mag.*) and the distance about 16 miles. An island called **Triangle Island** lies about 6 miles westward from Cape Manning, and about 3 miles from the shore of Nunivak Island, with reported foul ground between. The *Manning* passed about 1 mile northward of the island in depths of 7 to 9 fathoms.

Cape Etolin, the northern point, is a narrow strip of land about $\frac{3}{4}$ mile long. There is a ridge of low hills about midway of this outer strip. A small island lies about 2 miles off the end of the cape, with ledges between it and the point of the cape. A dangerous rocky spit makes westward for probably more than $1\frac{1}{2}$ miles from Cape Etolin.

On the southeast side of **Cape Etolin** there is an anchorage in Etolin Bay, which is a bight open northeast. This bay averages about $\frac{1}{2}$ mile wide and nearly $\frac{3}{4}$ mile long. Near the southerly side and about $\frac{1}{3}$ mile from the head of the bight an anchorage in 18 feet can be found; farther out it is deeper but more exposed to the effects of the strong tidal currents and rips of Etolin Strait. The holding ground is gravel and only moderately good. There is a small native winter village at the northwest corner of the bay.

In 1900 the *Manning* made a reconnaissance of Nunivak Island, and found a shoal (3 fathoms) about 10 miles 355° true (*NNW. mag.*) from Cape Etolin, with deep water between. Keeping Cape Vancouver bearing northward of 86° true (*ENE. mag.*), Cape Etolin can be rounded, when coming from westward, in 10 fathoms of water. With Cape Vancouver bearing

86° true (*ENE.* mag.) or eastward of this bearing, considerable shoal water and irregular depths are found.

Nash Harbor, on the north side of the island, nearly halfway between Cape Etolin and Cape Mohican, is a good harbor except with winds from northwest through north to northeast. On the western point at the entrance are a number of Indian graves, and at the head of the harbor is a frame house, which can readily be distinguished at a distance of 3 miles.

Tides.—The mean rise and fall at Nunivak Island is 3 feet. There is nearly 2 hours' difference in the time of tide on the north and south sides of the island.

It is stated that the tidal currents in Etolin Strait are so strong that the middle portion does not freeze over in winter.

ST. MATTHEW AND ADJOINING ISLANDS.

These are rocky, uninhabited islands, whose shores are little known and are poorly charted. During the season of navigation fogs are very prevalent in their vicinity and vessels should keep away from them. From what is known of them, anchorage may be made with an offshore wind on nearly all sides, though the shore should be approached with great caution.

Pinnacle Island is a remarkable narrow rock, about 1 mile long, 200 yards wide, and 900 feet high, which rises so abruptly from the water that there is scarcely a place for a boat to land. There are numerous small rocks near the island, and it should be avoided. Lieut. S. P. Edmonds, R. C. S., reports that from observation and bearings on Cape Upright and Sugarloaf Peak, Pinnacle Island is about 2 miles westward of the position shown on the chart.

ST. MATTHEW ISLAND,

Cape Upright, the eastern point of St. Matthew Island, is high and vertical, and the land in its immediate vicinity is mountainous; off the cape is a detached rock about 25 feet high. Westward of the high land of the cape there is a low neck, apparently of sand, and the cape might easily be mistaken for a detached island.

Glory of Russia Cape, the northwestern point of St. Matthew Island, is also high and mountainous, and the land between it and Cape Upright is a succession of hills and low valleys that extend across the island from north to south.

There are numerous detached rocks along all the shore of this island, which should not be approached too closely.

There is an abundance of fresh water on the island in streams and fresh-water lakes.

There is a good anchorage on the north side of the island in a bight $6\frac{1}{2}$ miles westward of Cape Upright, with Sugarloaf Mountain bearing 218° true (*SS W.* mag.), and westward of some outlying rocks which show well out of water and should not be approached closely. This anchorage is protected from southerly winds between southeast and southwest. Landing is difficult with any swell at all, as the beach is of stones and rather steep. With northerly winds anchorage can be had on the south side of the island.

Hall Island is high and rugged on its northeast, north, and west sides, and slopes to the southeast point, where it is low. There is a large detached rock off Cape Hall, and a number of detached rocks on the south side of the island. There is anchorage in 10 fathoms on the east side of the island in the bight where ruins are indicated on chart No. 8851.

Sarichef Strait is the passage between St. Matthew and Hall islands. The tidal currents and rips are strong, and the rocks on either side give it a bad appearance. It is said to be clear in mid-channel.

Tides.—The mean rise and fall at St. Matthew Island is 2.4 feet. The flood current sets eastward, and the ebb westward, at the rate of 1 to $2\frac{1}{2}$ miles.

CAPE VANCOUVER TO APOON PASS.

Cape Vancouver is a bold promontory, possibly 1,000 feet high. The shoal from the mouth of the Kuskokwim River is thought to extend along the coast to Cape Vancouver, so that on the south side of the cape the water is shoal. Immediately off the end of the cape there is deep water, which extends about 5 miles along the north side to the bight on which

the native village of Tanunak is situated. This bight is a series of mud flats, mostly bare at low water. The *Bear* anchored in $4\frac{1}{2}$ fathoms about 1 mile off the south point of the bight. From observation on that vessel, shoals extend off the mouth of that bight northwestward, and Hazen Bay is supposed to be shallow.

Father Barnum states that there are shoals parallel with the coast, behind which small boats go when coasting between Scammon Bay and Nelson Island. He is uncertain as to their exact limits and location, but they are believed to extend from the north entrance to Hazen Bay to, or nearly to, Cape Romanzof, with passages through in places.

Cape Romanzof is a bold and prominent headland with cliffs rising abruptly from the water over 1,200 feet along its western face; at the sharp extremity of the cape there are remarkable perpendicular shafts of rock on the side of the cliff. The cape is the western termination of the Askinuk Mountains, the highest of which (2,363 feet) is about 5 miles from the cape and can be seen a considerable distance at sea.

Northeastward of the cape, $4\frac{1}{2}$ miles, is the southern end of the Sand Islands. These two islands extend in a general north and south direction about 13 miles, including the interval between them, and at a distance from the coast diminishing from 7 to 5 miles. The north island is mostly covered at high tide.

The coast trends in an easterly direction from Cape Romanzof 15 miles to the mouth of Kun River, and throughout most of this distance is bordered by abrupt cliffs and hills gradually diminishing in elevation.

Scammon Bay lies between this shore and the south Sand Island. In general it is very shoal with numerous bars bare at low tide. There are two small coves along its south side, respectively 1 and 9 miles from Cape Romanzof, but both are quite shoal. There is a limited area with depth of 5 fathoms just south and east of the southern end of Sand Island, and there is a channel of the same depth leading into this and passing about $2\frac{1}{4}$ miles north of Cape Romanzof. A narrow channel with a minimum depth of about 2 fathoms continues through Scammon Bay and into the Kun River. There is 2 to 4 fathoms off Cape Romanzof but the water shoals quickly northeastward, so there is little protection except for very light-draft boats. There is a large shoal area with breakers about halfway between the cape and Sand Island, and another shoal with less than 2 fathoms lies $2\frac{1}{2}$ miles 338° true ($NW. \frac{3}{8} N.$ mag.) from the cape. Along the high land forming the south shore of Scammon Bay the water is 1 fathom or less in depth throughout its length, excepting just inside Cape Romanzof. The mean rise and fall of tides at the entrance to Scammon Bay is 5.2 feet.

North from the mouth of the Kun River the coast is low and marshy to the Yukon River mouths. It is reported to be extremely shoal between the northern Sand Island and this shore.

The bay south of Cape Romanzof has not been explored, but a number of bars, bare at low tide, were seen extending across its entrance between the cape and the north end of an island; near the latter there appeared to be a channel. The coast between Cape Romanzof and Nelson Island is low, and it is reported that the adjacent waters are shoal.

The **Yukon Delta** extends from the Black River to Apoon Pass, a distance of about 90 miles. The land along the coast is only a foot or two above high water, is covered with low marsh grass, and is entirely lost to view when but a few miles offshore. The only landmarks visible in clear weather are the sharp peaks of Kusilvak Mountain and the Askinuk Mountains back of Cape Romanzof, all very distant and often obscured by clouds or mist. The extreme flatness of the land and the remarkable mirage effect, often seen over the shoals when bare, make the whole region deceptive at times.

The river discharges by many mouths through the delta. The bars at the entrance have little depth, and the channels through the flats are narrow, crooked, and bordered by shoals bare at low water. They are also subject to constant change. Apoon Pass (see page 50) is the entrance used by the river steamers.

When well inside the confined banks, the country on each side is covered with an almost continuous growth of willow and alder bushes. The water has a brownish-white appearance,

something like glacial water, without its fine, sharp grit. It has no unpleasant taste, and is always fresh in the inner channels.

The main channels are everywhere free from snags, though trees are sometimes seen temporarily lodged on the bars, and quantities of driftwood are piled along the shores in places. Undoubtedly the ice freezes in and carries off the snags when it goes out each season. The channels and banks show indications of changing rapidly both from erosion and deposits. Very probably much of this is effected each year during the breaking up of the ice, its consequent jams, and the great floods following.

Inhabitants.—No white men live in the delta south of the Apoon except the Catholic missionaries at a summer fishing station. The native summer settlements near the mouths are shown on chart 9370. The natives are friendly and honest, and will attempt to pilot boats, with more or less success.

Currents.—None were observed to exceed 3 miles per hour. In the delta channels currents were observed varying from 0.5 to 1.6 miles. The velocities were greater in the bar channels and up the river.

Weather.—The prevailing winds in summer are northeasterly, easterly, and southeasterly; the strong blows are believed to come from the same directions. Fogs were unusual, but there was a good deal of thick mist and rain.

Yukon Flats.—The 6-fathom curve is about 10 miles westward of Cape Romanzof. From about 15 miles off Cape Romanzof the 6-fathom curve on the western edge of the flats has a general 24° true (*N. $\frac{3}{8}$ E. mag.*) direction for about 108 miles to latitude $63^{\circ} 32' N.$, longitude $164^{\circ} 58' W.$ At this point it turns to a general 87° true (*NE. by E. $\frac{7}{8}$ E. mag.*) direction for 61 miles to the west point of Stuart Island. On the western edge of the flats the 3-fathom curve is $1\frac{1}{2}$ to about 5 miles inside the 6-fathom curve, while on the northern edge the distance between the curves ranges from 5 to 10 miles. For a distance of 40 miles northward of Cape Romanzof detached shoals with $3\frac{3}{4}$ to 6 fathoms over them lie as much as 10 miles westward of the flats as described above, and deep-draft vessels should give the cape a berth of 30 miles to avoid these shoals. When in the vicinity of the flats vessels should not shoal the water to less than 8 fathoms.

ST. LAWRENCE ISLAND.

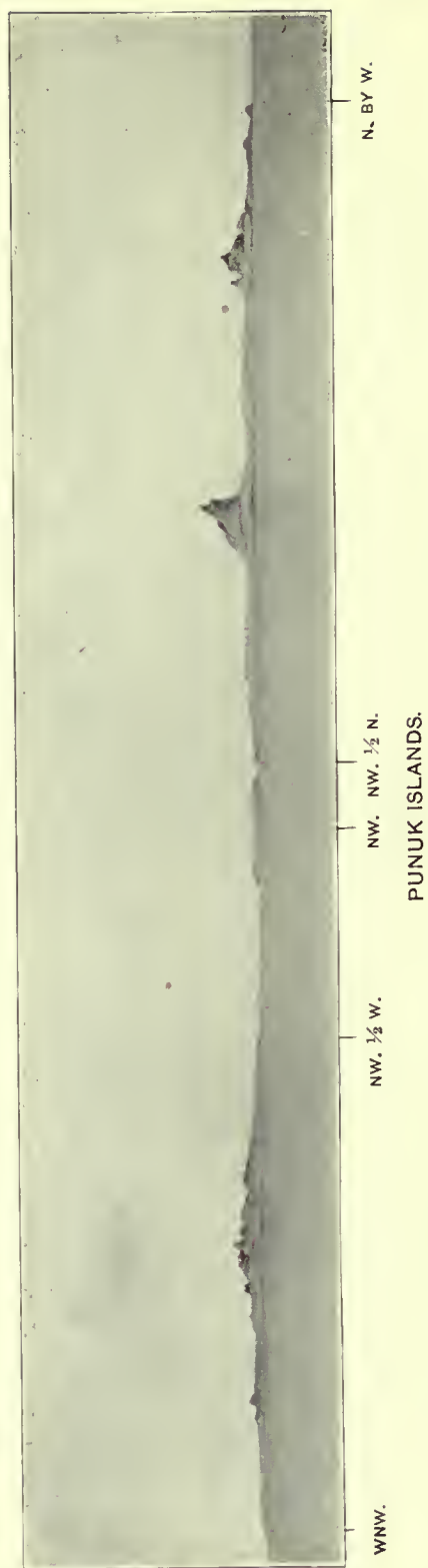
The eastern end of this island is usually made by vessels bound into Norton Sound, and in clear weather can be seen from a distance of 30 to 35 miles. From Southeast Cape a ridge of mountains extends in a northerly direction across the island, and another ridge extends in a northerly direction from East Cape to Northeast Cape. Between these two ridges a deep bight makes in from southward and at its head very low land extends northward across the island. The shore of the eastern end of the island is generally a low sand beach with outlying rocks; the mountain ridges begin $\frac{1}{2}$ to 2 miles back from the beach.

Northeast Cape is low tundra land, with numerous fresh-water lakes, 2 miles wide to the foot of a mountain which rises abruptly and has a peak 1,435 feet high which can be seen on a clear day a distance of 35 miles or more. At $\frac{1}{4}$ and $\frac{5}{8}$ mile from the end of the cape are two hummocks 94 and 280 feet high, respectively; the lower hummock is in latitude $63^{\circ} 17' 45'' N.$, longitude $168^{\circ} 41' 40'' W.$, as determined by the Coast and Geodetic Survey in 1902.

Although the bottom is irregular off the point of the cape, no break was noticed while passing it in rough weather. The north shore of St. Lawrence Island, for a distance of 10 miles westward of Northeast Cape, is a low sand beach and grassy tundra with numerous fresh-water lakes. Anchorage with shelter from southerly or southeasterly winds can be had along this shore about 2 miles from the beach in 8 to 9 fathoms of water; the holding ground is not good, the bottom being gravel. At a point on the north shore 6 miles westward of Northeast Cape, breakers extend 1 mile offshore.

From Northeast Cape the east coast of St. Lawrence Island has a general 192° true (*S. $\frac{1}{2}$ E. mag.*) direction for 4 miles to a point where a spur, 450 feet high, from the higher hills reaches to within $\frac{1}{2}$ mile of the beach. In this stretch the 6-fathom curve is $\frac{3}{4}$ to 1 mile offshore. A current observation made 2 miles southward of Northeast Cape and 1 mile





offshore gave a maximum velocity of 1.4 miles on both flood and ebb; the flood sets northward and ebb southward alongshore.

The east coast of the island then trends 209° true (*S. by W. mag.*) for 4 miles, and then curves westward and northward in a distance of 5 miles until it has a 322° true (*NW. by W. mag.*) direction, forming **East Cape**. The coast of this entire section is a low, narrow strip with a large lagoon back of it. East Cape is so rounding that there is no particular point to which the name applies. The mountains are about 2 miles back of it and are about 900 feet high.

Punuk Islands, lying 4 to 5 miles 164° true (*SE. by S. mag.*) from East Cape, is a group of three small islands $1\frac{1}{2}$ miles long; the northeastern end of the group lies about $13\frac{1}{4}$ miles 192° true (*S. $\frac{1}{2}$ E. mag.*) from Northeast Cape. The northernmost and largest island has two marked rocky hummocks, the higher having an elevation of 100 to 150 feet; on the southwestern end of the island are the remains of a native village. The southernmost island is an irregular mass of rocks, the highest point about 75 feet above water. Between these islands is a low, sandy islet, which is separated from the other two by narrow channels completely obstructed by ledges over which the sea breaks. The shores of all the islands are foul, and a ledge extends southward from the southernmost island; the *Patterson* passed 2 miles southward of the islands in a least depth of 8 fathoms. Vessels should approach these islands with caution.

A heavy break was observed in the channel between Punuk Islands and East Cape, and vessels should not attempt to pass through. From eastward the islands can be approached as close as 2 miles.

A current observation made $2\frac{3}{4}$ miles 220° true (*SSW. mag.*) from Punuk Islands showed the flood current setting about 24° true (*N. $\frac{1}{2}$ E. mag.*) with a maximum velocity of 1.1 miles.

Southeast Cape is about 5 miles across on its southern face; the eastern point of the cape slopes gradually to the water for a distance of $\frac{1}{4}$ mile from the high land, and a reef extends about $\frac{1}{2}$ mile southeast from the point. The western point is lower and slopes more gradually to the water for a distance of 3 miles from the high land, and a reef makes off from the point in a southerly direction for a distance of 2 to 3 miles. The bight between these points is very foul and should be avoided.

Cape Kialegak, about 5 miles northward of Southeast Cape, is a long sand spit strewn with rocks, extending in a northeasterly direction from the high land of the coast, and forms what is in appearance a good anchorage in southerly winds. There are breakers about $\frac{3}{4}$ mile 355° true (*NNW. mag.*) from the end of the cape, and there may be others inside; a reef extends southward from the south side of the sand spit for a distance of about 1 mile. The remains of a native village on the sand spit serve to identify the locality.

The deep bight westward of East Cape is little known; vessels have anchored well up toward the head of this bight. Vessels entering should give the points a good berth and exercise caution.

Cape Chibukak, probably 600 feet high, is a steep, black bluff, flat on top. There is a wide sand beach west of the bluff, on which is a native village called Gambell. This native village, and the one on Southwest Cape, are the only inhabited parts of the island.

The water is deep close to Cape Chibukak, and anchorage may be made on either side of the point of the sand beach off the native village, $\frac{1}{2}$ mile from shore, in about 7 fathoms, hard bottom.

The western end of the island, south of Cape Chibukak, is rolling land. From West Cape around to the bay east of Southwest Cape the land is mountainous, and abrupt close to the coast, being highest at Southwest Cape. Between the high land east of Southwest Cape and Cape Chitnak the land is low. A reef makes off 1 mile in a 220° true (*SSW. mag.*) direction from Cape Chitnak and is bare at low water. The submerged part of this reef extends about 2 miles in a general 175° true (*SSE. mag.*) direction from the bare part. This reef is dangerous, as the water shoals abruptly when approaching the cape. The rest of the island is generally high and rolling. There are some sunken rocks in the bight westward of Southeast Cape, and also some detached rocks showing off the north shore near Cape Kukuliak and North Cape.

It is probable that with care an anchorage may be found almost anywhere around the island, but the shores must be approached with caution.

Tides.—The mean rise and fall at St. Lawrence Island is probably about 1 foot at the east end, increasing to perhaps 2 feet at the west end. The time of high water probably changes rapidly from point to point, but no tidal observations have yet been made.

NORTON SOUND.

Norton Sound is at present the most important arm of Bering Sea. Some supplies for the Yukon River by way of St. Michael pass through it. The north shore is also important because of the mining operations now conducted there. The south side of the entrance to the sound is occupied by the extensive Yukon Flats, and should be avoided by deep-draft vessels. The rest of the sound generally has soundings of 8 to 12 fathoms, the greater depths being near the north side. Off Cape Nome and Cape Darby there are spots with depths of 15 to 19 fathoms. The bottom of the sound is very even, the depths decreasing to the shore with marked regularity, and the lead will indicate the approach to dangers, and should be kept going constantly. There is driftwood on all the shores of the sound.

Fog.—The remarks on fog, page 27, apply also to the region west of Cape Nome, but not to Norton Sound east of it. On entering the sound with thick weather in Bering Sea, the fog will almost always thin out and gradually clear as the vessel proceeds up the sound. At St. Michael fogs are rare.

Mirage.—In the vicinity of St. Michael and Stuart islands and the coast southward mirage often distorts the appearance of the land, small objects being sometimes greatly magnified.

Stuart Island lies northwest of St. Michael Island, from which it is separated by Stephens Pass, about $\frac{2}{3}$ mile wide in its narrowest part. Stuart Mountain, 483 feet high east of the center, is the highest point. The rest of the island is low and rolling, with some small, scattered peaks. The shore of the island is very irregular. From North Point to Observation Point and around through Stephens Pass is a line of conspicuous bluffs about 170 feet high; the rest of the coast is much lower. From Observation Point to the west point of the island the north shore is free from outlying dangers; 5 fathoms can be carried 1 mile from the beach. Off the west point, some detached rocks extend about 300 yards. On the east face of the island well toward the southeast point a shoal makes out about 3 miles.

St. Michael Island is separated from the mainland by a narrow, crooked, tidal slough, called St. Michael Canal. The island is generally low, and has two conspicuous elevations: St. Michael Hill, near the center, 472 feet high; and Stephens Hill, a sharp, conical hill overlooking Stephens Pass. There is a fixed white light on Cape Stephens, the western point of St. Michael Island. A reef extends $1\frac{1}{2}$ miles off Rock Point, the point 51° true (*NNE. $\frac{5}{8}$ E. mag.*) from St. Michael Hill, and is marked on its northeast edge by a buoy (spar, red, No. 2) in 20 feet of water.

Whale Island, lying close off the east end of St. Michael Island, is about $\frac{1}{2}$ mile long east and west, 118 feet high, and on approaching the harbor its east end is seen as a vertical bluff. It is marked on its eastern end by a fixed white light. The passage between this and St. Michael Island is blocked by rocks, bare at low water. Eastward and northward of the island the water deepens rapidly.

Beulah Island, about $\frac{1}{4}$ mile northwest from Whale Island, is about 50 feet high, small and rounded. It has bold water off its northeast side. Between this and Whale Island the water is shoal.

ST. MICHAEL.

St. Michael, on the east point of St. Michael Island, is the point of transfer from deep-water vessels to the Yukon River steamboats of the trading and transportation companies doing business on the Yukon and its tributaries. This trade during the open season of about four months is extensive. Some of the companies have small wharves for the light-draft river

vessels, and extensive warehouses on St. Michael Island and opposite on the mainland. Sea-going vessels discharge their cargoes by lighters. There is a wireless telegraph station, and communication by telegraph with the interior of Alaska and Seattle.

Supplies.—Coal can generally be had for steamers; water and general supplies can be had at St. Michael.

Repairs.—The facilities for repairs above water and to woodwork are good. Several blacksmith shops and small machine shops can handle ironwork and minor repairs to machinery.

Anchorage.—There is no harbor for seagoing vessels; the anchorage is an open roadstead exposed to winds from northwest through north to east. The larger vessels anchor in the offing between St. Michael Bay and Egg Island, and in heavy northerly gales shift their anchorage to get a lee under Egg Island or go to sea. Anchorage is found about $\frac{1}{2}$ mile south-eastward of Whale Island in $3\frac{1}{2}$ to 4 fathoms, bottom dark-blue mud and good holding ground.

Light-draft vessels and river steamers can find shelter from northerly and westerly winds by anchoring close in under the east side of the island, in 3 to 8 feet. The shores of St. Michael Bay are strewn with loose rocks, which are often frozen in the ice in winter and dropped as it goes out in the spring. Light-draft vessels, when anchoring in shoal water, should be careful not to anchor over any of these loose, scattered rocks.

Egg Island.—This island has been used as a quarantine station. Vessels detained at quarantine anchored off the eastern shore, where good water is found. The water off the western shore is deeper, 6 fathoms being found close inshore. The island is so small that it does not afford much protection in heavy weather, but it is the only lee to be had in northerly gales.

Tides.—See Coast and Geodetic Survey tide tables, in which the tides are predicted for every day of the current year during the season of navigation.

Ice.—The records of the Alaska Commercial Company from 1880 to 1899, both inclusive, show that ice begins to move out of St. Michael Bay between May 31 and June 25; the former being the earliest date recorded, and the latter the latest. The earliest date recorded for ice forming in St. Michael Bay is October 6, and the latest November 10; during the past ten years, however, the dates when ice formed ranged from October 18 to November 10. (See also page 26.)

ST. MICHAEL BAY TO CAPE DARBY.

The coast is generally low and rock strewn and the depths, when approaching it, shoal gradually from 6 fathoms toward the beach; a depth of 3 fathoms can be taken as close as $\frac{3}{4}$ mile except in a few places. There are no outlying dangers, but a reef makes off about $\frac{1}{2}$ mile from the shore 2 miles southward of **Black Point**, the point about 36 miles northeastward from St. Michael. **Tolstoi Point** and its vicinity are high and rocky, and from there to Unalaklik River the shore is low. A shoal extends about $1\frac{1}{2}$ miles off the mouth of the Unalaklik River; there is no channel through this shoal into the river except for light-draft craft. Good anchorage, in southerly winds, is found in the bight eastward of **Kiktaguk**, about 15 miles eastward of St. Michael. There are a number of native villages on this coast, and a depot for supplies at Unalaklik.

Besboro Island is 600 feet high and very prominent; on a clear day it can be seen from St. Michael; it affords a poor lee, as the wind draws all around the island. A shoal, with depths of 4 to $4\frac{3}{4}$ fathoms, makes off 2 miles in a northeasterly direction from the north end of the island; the western side of the island is bold-to, and the eastern side of the island can be approached as close as $\frac{1}{2}$ mile, with a depth of over 5 fathoms.

Cape Denbigh is a moderately high, rounded hill, joined to the mainland by a low, narrow neck. The head of the bight, eastward of the cape, is shoal, but in approaching the water shoals gradually. A good anchorage in northeasterly winds can be had eastward of the cape in depths suitable to the draft of the vessel. The south end of the cape is bold-to, and its western side, $2\frac{1}{2}$ miles northward of the point, can be approached close-to in 4 fathoms of water. The water shoals rapidly inside a depth of 4 fathoms when approaching the shore.

Norton Bay is generally shoal. About midway between Point Dexter and Bald Head there is a depth of about 6 fathoms, and from this depth the water shoals gradually, as the shores are approached in any direction inside of Bald Head. In some places the 6-foot curve is 5 miles or more from the beach. The north shore of the bay for a distance of 15 miles westward of Bald Head is comparatively low, and the water is shoal for some distance from the shore. From a point 15 miles west of Bald Head to Cape Darby the land is high and wooded along the coast; a few native villages are located on this stretch. For a distance of 20 miles northeastward from Cape Darby a depth of 4 fathoms can be taken $\frac{1}{2}$ mile from the shore, and in some places much closer. The water shoals gradually on approaching the coast, but the south and east sides of Cape Darby have deep water close-to. During strong northerly winds the water is lowered considerable in Norton Bay.

Cape Darby is a high, rounded mountain, which terminates at the water in steep, rocky bluffs. **Rocky Point** is a high, bold promontory with irregular rocky cliffs.

GOLOFNIN BAY,

the entrance to which lies between Cape Darby and Rocky Point, with a width of 10 miles, extends in a general northerly direction for 12 miles to the entrance to Golofnin Sound. The east shore is high and bold, with occasional sand and gravel beaches. **Carolyn Island**, low and rocky, lies $\frac{1}{4}$ mile off the east shore, about 8 miles north of Cape Darby. The west shore for about 3 miles north of Rocky Point is high and bold, but beyond this is a low sand beach, with a prominent point about 5 miles north of Rocky Point. At the head of the bay on the west side, the entrance to Golofnin Sound lies between a sand spit projecting from the eastern shore, and a low sand island extending northward from the west shore and connected with it at low water.

Deep water can be carried close under Cape Darby and Rocky Point. Eastward of Rocky Point is an extensive middle ground on which the least depth found was $3\frac{3}{4}$ fathoms; on its east edge it rises abruptly from 6 and 7 fathoms. With the exception of this middle ground the bay is free from dangers south of the low point on the west shore, the deepest water being on the east side, and ranging from 11 fathoms close under Cape Darby to 4 fathoms $\frac{1}{2}$ mile northwest of Carolyn Island. In the south part of the bay the high land may be approached closely, but off the low land the 3-fathom curve is in places nearly 1 mile offshore.

Anchorage.—A little westward of the southern sand spit, in the entrance to Golofnin Sound, anchorage may be had in 6 to 7 fathoms, with protection from all winds. For vessels whose draft prevents the use of this anchorage, the best is off the point on the west side of the bay in about 4 fathoms. This is unsafe in southerly weather, but is the most convenient for communicating with the head of the bay. By shifting anchorage from one side to the other in Golofnin Bay, good shelter is found from easterly or southwest or westerly winds.

Golofnin Sound.—In the north part of the bay an extensive shoal, with 4 to 8 feet, makes out in a northeast direction from the west shore to within $\frac{3}{4}$ mile of the east shore, its extremity lying about 2 miles 93° true (*ENE. $\frac{3}{8}$ E. mag.*) from the north point of the low sand island on the south side of the entrance to Golofnin Sound. The channel leading to the entrance to Golofnin Sound lies on the eastern side of the bay, passing around the east end of the shoal and following the eastern shore at a distance of $\frac{3}{8}$ to $\frac{3}{4}$ mile, with an average width of 800 yards. The least depth in the channel is 13 feet at low water, but 15 feet has been taken in at high water. The rise and fall of the tide (diurnal) is about 3 feet, but this is influenced by the prevailing winds, which have a tendency to bank up the water in heavy southerly weather, and to lower it with northerly and northeasterly winds.

Cheenik (Golovin post office), on the north spit at the entrance to Golofnin Sound, is a distributing point for the mining district of the Fish River country.

Golofnin Sound is very shallow and is navigable for small steamers of $3\frac{1}{2}$ feet draft which ply from Golofnin to the mouth of the Fish River, which empties into the head of the sound. The channel through the sound is narrow and tortuous.

ROCKY POINT TO CAPE NOME.

For about 22 miles, from Rocky Point to Topkok Head, the land is high and bold, in many places rising abruptly. Beyond this to Cape Nome the coast is low with high land farther back. Immediately behind this low land is a large shoal lagoon with two small entrances, the west one called Port Safety. Between Rocky Point and Cape Nome the water is deep, the bottom regular, and by giving the shore a berth of 1 mile a depth of 6 fathoms, or more, will be found.

Topkok Head is 22 miles westward of Rocky Point, and is the first high land close to the coast eastward of Cape Nome. Its seaward face rises abruptly from the water 586 feet and is a well-known and conspicuous landmark.

A yellow bluff, 572 feet high, on the east side of Bluff post office, about 6 miles eastward of Topkok Head, is conspicuous, but not as much so as Topkok Head.

Solomon is a post office at the mouth of Solomon River, 11 miles westward of Topkok Head and 17 miles eastward of Cape Nome. A railroad is under construction up Solomon River. From a survey made in 1902 there was a depth of 3 feet on the bar at the entrance and inside Solomon River, but local knowledge is necessary to keep in the best water.

Port Safety is a small anchorage for vessels of less than 7 feet draft; it is about 8 miles eastward of Cape Nome. The channel is narrow and has a depth of 7 feet. Small vessels can anchor in the narrow sloughs which lead between the flats inside the entrance.

DIRECTIONS FROM UNIMAK PASS OR FROM CAPE KALEKTA TO NORTON SOUND OR PORT CLARENCE.

For vessels of any draft.—If no observations can be obtained on account of thick weather, the lead must be depended upon and used constantly, as the currents are liable to set a vessel off her course.

To avoid Nunivak Island, and also to sight the island in clear weather so as to check the vessel's position, the course should be laid to pass about 18 miles westward of the island in latitude $60^{\circ} 14' N.$ and longitude $168^{\circ} 04' W.$

I. *From a position 5 miles 254° true (S W. by W. mag.) from Cape Sarichef lighthouse,* on the eastern side at the northern end of Unimak Pass, a 344° true (NW. by N. mag.) course made good for 353 miles should lead to the above latitude and longitude, and Cape Mohican should bear about 95° true (ENE. $\frac{7}{8}$ E. mag.) and be distant 18 miles.

II. *Or, from a position 3 miles westward from Cape Kalekta* a 352° true (NNW. $\frac{1}{4}$ W. mag.) course made good for 376 miles should lead to the above position with Cape Mohican bearing 95° true (ENE. $\frac{7}{8}$ E. mag.) distant 18 miles.

On the above courses little can be said of the currents except that with a strong wind from any direction a current is likely to set with it. A slight northerly set will sometimes be experienced. Thick weather is the rule in Bering Sea during the season of navigation and care should be observed when in the vicinity of Nunivak Island (see also the description of Nunivak Island, page 38).

III. *From Cape Mohican* bearing 95° true (ENE. $\frac{7}{8}$ E. mag.) distant 18 miles, a 4° true (N. by W. $\frac{1}{4}$ W. mag.) course made good for $166\frac{1}{2}$ miles will lead to a position in latitude 63° N. and longitude $167^{\circ} 40' W.$; the highest peak (1,462 feet) 3 miles back of Northeast Cape, St. Lawrence Island, should then bear 300° true (W. by N. mag.), distant 35 miles, and will be visible in clear weather at this distance. From this position:

IV. *If bound to St. Michael.*—Make good a 53° true (NE. by N. mag.) course for $76\frac{1}{2}$ miles to a position in latitude $63^{\circ} 46' N.$ and longitude $165^{\circ} 24' W.$ On this course the depth should be 12 fathoms or more until the vessel has arrived at the above position. From the above latitude and longitude a 93° true (ENE. $\frac{1}{2}$ E. mag.) course made good for 81 miles will lead to a position 3 miles northward of Stuart Island with Stuart Mountain bearing 201° true (S. mag.). From this position make good a 126° true (ESE. $\frac{3}{4}$ E. mag.) course for $14\frac{1}{2}$ miles, giving the shore of St. Michael Island a berth of 3 miles. Whale Island light should then bear on the

starboard beam distant $3\frac{1}{2}$ miles, and deep draft vessels can anchor in this position in about $5\frac{3}{4}$ fathoms. (See also "Anchorage," page 45.)

On the 93° true (**ENE.** $\frac{1}{2}$ **E.** mag.) course the lead should be frequently used, and if the water is shoaled to less than 8 fathoms while westward of Stuart Island it is pretty safe to assume that the vessel is southward of her course. Thick weather is not as prevalent in Norton Sound as in Bering Sea, and it is but seldom that Stuart Island and the mountains south-eastward of St. Michael can not be seen and used as landmarks.

V. *If bound to Golofnin Bay.*—Follow the directions in section IV, and when the vessel is in latitude $63^\circ 46'$ N. and longitude $165^\circ 24'$ W. make good a 59° true (**NE.** $\frac{5}{8}$ **N.** mag.) course for 71 miles, which should lead to a position about 2 miles southeastward of Rocky Point (the high point on the western side of the entrance to the bay).

VI. *If bound to Nome.*—From a position in latitude 63° N. and longitude $167^\circ 40'$ W. make good a 33° true (**N.** by **E.** $\frac{1}{4}$ **E.** mag.) course for 100 miles, which should lead to a position about 8 miles from the beach abreast the town. Anchor according to draft, as indicated in the description of Nome on page 51.

VII. *If bound to Port Clarence.*—From a position in latitude 63° N. and longitude $167^\circ 40'$ W. a 0° true (**N.** by **W.** $\frac{5}{8}$ **W.** mag.) course made good for 133 miles will lead to a position about 8 miles from Cape York. Then follow the directions under heading, "Port Clarence."

On the 0° true (**N.** by **W.** $\frac{5}{8}$ **W.** mag.) course, King Island should be left about 8 miles on the port hand when the vessel has been standing 119 miles on this course. A northerly or northwesterly set of the current may be found after the vessel has stood about 90 miles on the course. In clear weather the mountains back of Cape York should be sighted after King Island has been passed and the cape should be made on the starboard bow. The depths until abreast King Island range from 15 to 20 fathoms; but northward of King Island the soundings are irregular and care should be taken not to be set eastward toward the shoals which lie off the coast between Cape Douglas and Point Spencer (see page 53).

GENERAL DIRECTIONS FROM ISANOTSKI STRAIT TO ST. MICHAEL.

The following remarks are intended to apply only to small craft and river steamboats.

After passing out of Isanotski Strait, clear of the outlying breakers, the course is shaped for the east side of Amak Island. Shelter can be found on the south, southeast, and east sides of the island. Some of the Moran fleet found shelter in 1898 on the east side in about 6 fathoms. Capt. J. L. Fisher states that he crossed pretty close inshore over the indicated shoal off the southeast end, with a least depth of 7 fathoms. He also states that the outlying rocks and reefs off the north end of the island appeared very nasty and dangerous.

Leaving Amak Island, the next course is laid for Cape Newenham. Shelter can be obtained it is believed, on either side, according to the wind. On July 15, 1898, the bight northeast from Cape Newenham was found packed full of ice.

From Cape Newenham the course is laid for Nunivak Island. If heavy northerly or northeasterly winds are encountered before the island is reached, shelter is sought in the depth of the bight on the south side. Weather conditions being good, it is only necessary to touch at this island if needing water. The anchorage on the north side, about 12 miles eastward of Cape Etolin, is considered the best. (See Nunivak Island, page 39.)

From the northern end of Nunivak Island the customary course is to cross over diagonally to a little north of Hazen Bay, and then coast along just outside the shoals, in 3 to 5 fathoms of water, until Cape Romanzof is reached. If the weather is unpropitious or water is required, an anchorage in Scammon Bay is made close inshore on the south side, in a bight where a stream empties.

After leaving Scammon Bay, by giving the spit on the north side of the entrance a good berth, the remaining distance to St. Michael is made by skirting along on the outer portion of the Yukon Flats, in 2 to 5 fathoms, where the courses are exclusively guided by the use of the lead. On this crooked stretch, after the mountains of Cape Romanzof and the Kusilvak Mountains disappear, no land will be visible until the high peaks on the mainland south from Stuart

Island are sighted; a little later the summits of Stuart and St. Michael islands become visible. After Stuart and St. Michael islands become defined, the course is shaped to go through the pass between them, and then skirt around the north side of St. Michael Island to St. Michael.

In the summer, from all that can be learned, northerly and easterly winds prevail a large portion of the time between Cape Newenham and Cape Romanzof.

The tidal currents in Etolin Strait are strong and at times cause heavy tide rips.

COAST FROM ST. MICHAEL TO APOON PASS.

St. Michael being the end of deep-water navigation, all the Yukon traffic beyond this point has to be conducted with vessels drawing 5 feet or less. The larger river steamboats leaving St. Michael Bay go around the north side of St. Michael Island and through Stephens Pass, between St. Michael and Stuart islands. They give the reef off Rock Point, on the north side of St. Michael Island, a wide berth, and after passing between the islands a straight course is made slightly westward of Point Romanof. When the summit of Point Romanof is abeam, distant about $1\frac{1}{2}$ miles, the direction is changed and a course is made for the range beacons for entering the Apoon Pass. The most dangerous portion of the passage is the 14 miles around the north end of St. Michael Island, which is exposed to the deep-water swell from the north. This can be avoided by small craft by going through St. Michael Canal.

St. Michael Canal separates St. Michael Island from the mainland, and is a narrow, crooked, tidal slough, which forks and comes together again. The distance through by way of the north fork is 18 miles, and by the south one 20 miles. The southern and longer one is the wider, and for that reason is the one generally used. There is a sufficient depth in the canal for ordinary river steamboats, but its northern entrance, which has some scattered rocks in it, is too shoal to enter at low tide. The southern entrance has about 3 feet on its bar at mean low tide. Thus far, on account of its narrowness and sharp curves, it has only been used by the smaller class of steamboats.

From Stephens Pass to Apoon Pass is 42 miles along an open coast, but owing to the protection from heavy seas offered by the flats that extend seaward, it is safe in summer months for the flat-bottomed river steamboats that have to traverse it.

With the exception of the promontory of Point Romanof, the immediate coast is low and flat all the way from St. Michael Island to and including the Apoon entrance. The promontory of **Point Romanof**, 340 feet high, stands well out about 12 miles westward from the high hills of the coast range. After clearing Stephens Pass it appears in clear weather like an island in the sea. Coming north from the Apoon entrance after passing Point Romanof, Crater, St. Michael, and Stuart mountains appear above the horizon, and afford excellent marks.

In moderate weather the ocean swell is not felt between Stephens Pass and the Apoon entrance; but in heavy weather and westerly weather, which is more likely to occur during the latter part of the season, there is a choppy sea which is heavier off Point Romanof than elsewhere. In general, after rounding the north side of St. Michael Island, this passage is safe for river steamers in the summer season. During the latter part of the season, however, high winds become more frequent, and the boats are obliged to watch their opportunities.

Anchorage.—River steamboats anchor on the flats or in the channel, wherever exigency demands.

Good shelter can be had in all but southwesterly weather in the cove on the south side of Cape Stephens, in 6 to 9 feet of water. Stebbins, a large Eskimo settlement, is located on this cove.

In the southern end of **St. Michael Canal**, in the southern branch, just above the junction, there is a good and safe anchorage in all kinds of weather. There is only about 3 feet at mean low tide on the outside bar, and it has to be crossed at high tide.

About 10 miles southward of Canal Point is the **Pikmiktalik River**. In the mouth of the right-hand stream there is anchorage for medium-sized steamers. The bar to this stream has only about $2\frac{1}{2}$ feet on it at mean low tide. A shoal extends out from the south point at the entrance.

The mouth of the **Pastoliak River**, about 2 miles from the outer end of the Apoon Pass, affords anchorage for steamboats under medium size. The Apoon Flats extend in front of the entrance, and it can only be entered at high tide.

. APOON PASS.

This is the most northern outlet of the Yukon River, and is about 55 miles, via Stephens Pass, from St. Michael. It is used exclusively by the steamboats trading up the Yukon and its tributaries.

Apoon Pass is the extreme northeastern limit of the Yukon Delta. In common with the rest of this region, the country is low and flat, it being 1 to 2 feet above high-water mark. Down to within about 2 miles of its mouth, the banks are generally covered with low willow and alder bushes 8 to 10 feet high. Near the mouth the land becomes more marshy, and a considerable area westward appears to be entirely an open marsh. The open country eastward is flat, and is made up of marsh, ponds, and tundra. The only high ground in the general vicinity is **Hogback**, a rounded ridge about 300 feet high lying 5 miles east from the entrance. Some distance back from the coast, 12 to 18 miles, is seen the range of hills or mountains trending southwestward, which extend in that direction to where the Yukon makes its great bend to get around the end of this ridge. On these low, flat shores there are often remarkable mirage effects, tending greatly to magnify insignificant objects.

Bar.—Off the mouth of Apoon Pass, and for some distance northwestward, the bottom is nearly flat, having a depth of about 2 feet of water at low tide, and with little choice as to a channel. All but very light-draft vessels must time their departure from St. Michael so as to cross these flats at high tide, or must wait for the tide.

The distance between the Apoon mouth and the head of the delta is traversed by going up the Apoon Pass about 31 miles to where it branches off from the Kwikpak Pass, and then up the Kwikpak about 30 miles to the head of the delta, where it and the Kwikluak Pass separate the Yukon into two principal mouths. The channels and banks are subject to rapid change both from erosion and deposit.

Inhabitants.—The natives are mostly migratory, living at different places at different seasons. Their principal settlement, after leaving St. Michael Island, is on the Pastolik River. Kotlik, about 6 miles from the Apoon mouth, on the Kotlik River, has a store, Greek church, and a few dwellings. New Fort Hamilton is on the Kwikpak, 36 miles above Kotlik, where there is a station of the North American Trading and Transportation Company.

Pilots.—River steamboats in general carry Eskimo pilots, who may be hired at St. Michael and at various places on the river. They are, as a rule, familiar only with a portion of the river, those from St. Michael usually going up as far as Andreafski. A number of native pilots live at the village near the mouth of the Pastolik River. Except with local knowledge a pilot is necessary in following the Apoon. The Eskimos are generally quick-witted and have a good eye for the water; but some who offer their services as pilots have little idea of the requirements of a steamer, being used only to their own skin boats.

Tides.—The tropic rise and fall in Apoon Pass is 4.8 feet. The tides at this entrance, as is the case with the shores of eastern Norton Sound, are greatly affected by the winds, northerly and easterly ones making low waters, and southerly and southwesterly ones making high waters. The wind effect may be sufficient to entirely obliterate the natural tide conditions. The effect of the tides reach above the head of the delta. At the head of the Kwikpak Pass the rise and fall is about 6 inches.

Current.—The ordinary outflow of the Apoon is much less rapid than other mouths of the Yukon; but there is a tidal inflow and outflow, the velocity of which depends upon the amount of the rise and fall of the tide at any particular time.

Ice.—In the fall thin ice begins to make in the river the latter part of September, and navigation in October is attended with danger of being frozen in. It is more than probable that the movement and clogging of the ice in the breaking up of the river in spring has much

to do with the location and peculiarities of the channels and with clearing it perfectly from snags.

Supplies.—Immediately within the Apoon mouth the water is fresh, and that on the flats outside, close in, is nearly so, the degree of freshness depending upon the stage of the tide.

Cord wood is cut and sold by the natives along the river from the mouth up. Small wood piles can be seen at intervals. That in the delta, and more particularly near the mouth, is of inferior quality, being cut from wet driftwood.

COAST FROM CAPE NOME TO BERING STRAIT.

Cape Nome is a bluff, about 300 feet high, apparently 1 mile broad, and rounded down to the water on either side, where there is low land at the shore, with higher land farther back. The water off this cape is quite deep. The tropic rise and fall of tides at Cape Nome is 2.1 feet.

From Cape Nome to Cape Rodney the coast, except abreast of Sledge Island, is a comparatively straight stretch of low sand beach with no projecting points and the higher land some distance back. Abreast of Sledge Island for a distance of several miles the hills slope down to the beach, giving this part of the coast the appearance of a point. The stretch of beach is broken by a number of small rivers where mining is in progress. The entrances to Nome, Snake, Penny, and Sinuk rivers have shifting bars, but there is generally water enough in the channels over these bars to permit steamers of 4 feet draft to enter. When approaching the coast, between Cape Nome and Sledge Island, the water shoals regularly and gradually until a depth of 5 fathoms is reached; inside this depth the bottom is irregular, especially near the mouths of the rivers.

A small shoal, with about 18 feet over it, lies about 9 miles westward of Cape Nome and $2\frac{1}{4}$ miles offshore. Shoals extend a comparatively short distance off the mouth of Nome River.

Nome is on the beach at the mouth of the Snake River, about 11 miles westward of Cape Nome. The general anchorage for deep-draft vessels is in 7 fathoms, about 1 mile from the beach abreast the town. Vessels of less draft anchor in 5 fathoms, a little closer to the beach, but it is not advisable to anchor in less. In strong southerly winds no landing can be made on the beach, and the anchorage is unsafe. Southerly winds raise the water and northerly winds lower it. At Nome there is a relief station of the United States Public Health and Marine-Hospital Service for the treatment of seamen and a wireless telegraph station. There is a railroad up the Nome River to Lanes Landing on the Kuzitrin River, the latter emptying at the head of Imuruk Basin.

Sledge Island, about 31 miles west of Cape Nome and $4\frac{1}{2}$ miles offshore, is a rocky, flat-topped island rising 604 feet above the water, and comparatively rounded in outline. There is a native village on a small, rocky slope on the east side; excepting this and a short sand spit making off from the northern end of the island, the shores are steep. The island may be safely approached from any direction, and anchorage may be had on all sides of it; the bottom is rocky in spots. A depth of $6\frac{1}{2}$ fathoms has been found about $3\frac{3}{4}$ miles offshore and about $7\frac{1}{2}$ miles eastward from Sledge Island. During heavy weather tide rips, or breakers, have been observed about $\frac{3}{4}$ mile eastward from the northern point of the island; a depth of 5 fathoms is reported near this locality.

A depth of 3 fathoms, hard clay and boulders, is reported 7 miles westward of Sledge Island and 4 miles from the beach just eastward of Cape Rodney.

From Cape Rodney to Cape Douglas the shore is a low sand beach, and the high land is farther inland from the beach than eastward of Cape Rodney. This coast is seldom approached close-to; the water is comparatively shallow, and dangerous shoals and ledges are found between Cape Douglas and Point Spencer. Vessels are cautioned to exercise care when approaching the shore while southward of Cape Douglas, and to give the shore between Cape Douglas and Point Spencer a berth of over $\frac{1}{2}$ miles.

Currents.—A tidal current is perceptible from Cape Nome to Cape Rodney, but the strongest current sets northwestward; lying at anchor, vessels usually tail northwestward. In the vicinity of Sledge Island and between the island and the mainland the currents have considerable velocity; with strong southeast winds an average velocity of 2 miles and a maximum velocity of $3\frac{1}{2}$ miles per hour have been observed setting northwestward. Vessels, when in this vicinity, should give special attention to the currents. Above Cape Rodney there is no perceptible current southward or eastward; the general set is northward and westward.

King Island is rugged and rocky, about 2 miles square, and 700 feet high. It has nearly perpendicular cliffs, deep water, and generally rocky bottom on all sides. There is a native village on the south side, the houses being built in the sides of the cliffs some distance above the water. Off the village, but close inshore, vessels may anchor in about 15 fathoms, muddy bottom, with good protection from northwest winds. In clear weather the island is an excellent landfall for vessels coming from southward and bound to Port Clarence.

Cape York is a high, rocky, nearly vertical cliff, with numerous ravines, and a range of high, rugged mountains immediately back of it. The cliff is about 10 to 12 miles in extent. There is no distinct promontory, and no exact point along the cliff that can be defined as the cape. The water shoals slightly off the western end of the cliff, but nothing less than 6 fathoms will be found at a distance of $2\frac{1}{2}$ miles from shore. A shoal with 2 fathoms is reported about $1\frac{1}{2}$ miles southeastward of the cape.

A rock is reported about $\frac{3}{4}$ mile from the shore southeastward of York village.

Between Cape York and the high land of Cape Prince of Wales there is a bight, with comparatively low, rolling land back of it extending across the peninsula to the northern shore. The beach is low, and the water shoals gradually when approaching the shore. The eastern part of the bight is slightly shoaler than the western part, about 6 fathoms will be found 1 mile offshore; in the western part of the bight 8 fathoms will be found at the same distance from the beach. When standing westward alongshore, and when abreast of Cape Mountain, the water deepens suddenly to 20 fathoms.

PORT CLARENCE

is a good harbor, close to the strait, free from ocean swell, and is clear of ice about June 25 to 30. The bay is formed by a sand spit which extends from the mainland about 10 miles in a northerly direction to Point Spencer. The point is bold, with depths of 7 fathoms as close as $\frac{1}{4}$ mile.

The channel between Point Spencer and Point Jackson, on the north shore, is about 4 miles wide, clear of danger, and carries 7 to 9 fathoms. One and one-half miles south of Point Spencer a shoal makes into the bay from the sand spit, with depths of $2\frac{1}{2}$ fathoms 1 mile off. The northern half of the bay has a general depth of 7 fathoms as close as 1 mile from the shore; the southern half of the bay shoals gradually from this depth toward the shore, and the extreme southern part is very shoal. The north shore is clear of danger, and can be approached as close as $\frac{1}{4}$ mile, the soundings decreasing regularly to the beach.

Port Clarence connects at its northeast end with **Grantley Harbor**, which is 2 to 3 miles wide, about $8\frac{1}{2}$ miles long, and connects at its eastern end by a narrow, difficult channel with Imuruk Basin. The mouth of the harbor is formed by two sand spits which slightly overlap; on the southern spit is the settlement of **Teller**, a post office and distributing point for supplies for this section. The water westward of the sand spits is shoal, but there is a channel close to the north one which can be used by vessels drawing 12 feet or less, but which should be sounded out before attempting to enter. Inside the harbor the depths range from $2\frac{1}{2}$ to 3 fathoms, and it is probable that a draft of 12 feet can be taken through the channel to the basin. Vessels have gone into Grantley Harbor to heave down and repair on the north sand spit. **Bering** is a settlement on the eastern shore of Port Clarence about 5 miles south of Teller.

Fresh water can be obtained in several places in Port Clarence, the best being from a stream on the east side near Bering.

Anchorage.—There is anchorage in 5 fathoms, just inside Point Spencer; also in 5 fathoms $1\frac{1}{2}$ miles off Teller, the village bearing 116° true (*E. $\frac{1}{2}$ S. mag.*), exposed to southwest winds only.

Fog.—In this vicinity fog is quite prevalent and very dense in summer.

Tides.—The mean rise and fall in Port Clarence is 1 foot. Southwesterly winds increase and northeasterly winds decrease the height of tide.

Current.—Outside of Point Spencer the current sets northwestward with a velocity of 1 to 2 miles per hour.

GENERAL DIRECTIONS TO PORT CLARENCE.

In approaching Port Clarence in thick or misty weather the long, low spit of sand and shingle which forms the west side of the bay is not seen until close-to. The best course from southward is to steer directly for Cape York, bearing in mind the set of the current northwestward, and after making Cape York follow along the coast eastward until the entrance to Port Clarence is made out, then steer for the anchorage just inside Point Spencer. Or, follow the north shore at a distance of about 2 miles until abreast the settlement at Teller.

Dangers.—A ledge with a reported least depth of $1\frac{3}{4}$ fathoms lies nearly 5 miles offshore and about halfway between Cape Douglas and Point Spencer, and vessels should keep well outside of it. Extending about west-northwest from this ledge toward Cape York is a ridge with hard bottom and depths ranging from 4 fathoms near its southeastern end to 5 fathoms in about the latitude of Point Spencer. Spots with depths of 6 fathoms over them will be found 15 miles offshore westward of Cape Douglas. It is recommended that vessels approaching Port Clarence give the lowland between Cape Douglas and Point Spencer a berth of not less than 5 miles before hauling in for the entrance.

ARCTIC OCEAN.

The remarks on the navigation of Bering Sea (page 25) apply generally to the Arctic Ocean as far as Point Barrow, except that the current and soundings in the Arctic are more uniform, and, with the exception of the shoals at Cape Prince of Wales, Hotham Inlet, Blossom Shoals, and Point Franklin, there are no outlying dangers, and the lead is an excellent guide in approaching the land. Another exception is that in the Arctic the question of ice must always be considered. The following remarks on the navigation, weather, and currents of the Arctic Ocean, by Capt. M. A. Healy, R. C. S., contained in the report of the cruise of the Revenue steamer *Corwin* in the Arctic Ocean, 1884, though relating to an extreme season, may be of interest to those navigating these waters:

“In my previous experience in the Arctic I have never seen a season like the past. From the time of first reaching the ice up to leaving the Arctic, dense fog has been almost constant. Currents that have hitherto been considered permanent in direction, if not in force, have become erratic, and others have entirely failed. The ice fell back before the sun’s advance slowly and compactly. For three weeks after we reached the Diomed Islands it refused entrance into Kotzebue Sound, and three weeks later still it was hanging with discouraging tenacity around Point Hope. It was unsafe to anchor with any but a short scope, moving steam had to be kept, and constant vigilance exercised to prevent being dragged ashore by fields of ice moving in the rapid and changing currents. For weeks at a time it was impossible to take observations, dead reckoning was almost worthless, owing to the continual changes in force and direction of the currents, and the safety of the ship depended entirely on the constant use of the lead. Fortunately for those who are obliged to sail this frozen ocean, the depth of water is not so great but what bottom can always be obtained, and the proximity of land is indicated by regular shoaling, with but few exceptions.

Yet with this aid and the best charts that we have, several years' experience is necessary to enable the navigator to judge with any degree of precision the position of the ship. Anyone at all familiar with coasting knows how difficult it is to recognize land in a fog, where marks are well defined—high bluffs often appearing like low beaches and small rocks looming to gigantic size, while the general contour of the small portion of the shore visible may be taken for almost any land that one expects to make. How much more difficult must it be where the formation of the shore for miles differs but little, as is the case in the Arctic.

"Among the best landmarks that we have in these northern waters are the bird rookeries at King Island, the Diomedes, Cape Seppings, Cape Thompson, and Cape Lisburne. The distance between these rookeries enables one to form a very accurate idea of the one he is approaching, while the cries of birds congregated at them answer the purpose of a fog signal. With one or two exceptions, these are the only aids to navigation.

"In the shallow waters of this ocean the effect of the wind on the currents is very marked.

"Inside the Arctic circle snow has fallen all the past season, and it may almost be said that there has been no summer. As late as August 27 ice was within a few miles of Cape Sabine, and at the Seahorse Islands it was heavy and dangerous. The pack at this time was still southward of Point Barrow, and vessels could not go eastward of that place this season. During the latter part of our stay the weather was exceptionally severe. About the Fox Islands heavy storms were frequent and rain almost incessant.

"The experience of many years in the Arctic has demonstrated the fact that no rules whatever can be given as to the time of the breaking up of the ice. The severity of the winter, the time at which spring weather opens, and the beginning of southerly winds that break up the ice, all have their influence in governing this time. Vessels have been able to enter St. Michael as early as May 21; this year we found ice to the southward of St. Matthew Island on June 2, and some days later still in the season vessels have been stopped by it between the Seal Islands and Nunivak. The southern limit of the ice is almost entirely dependent on the severity of the winter. Heavy southerly winds and swell will break up the ice, and if followed by northerly winds it will open out and the waters become navigable. When once broken up, if the weather is mild, it will not cement again if nipping, and consequently will open more readily to light winds. Northeast winds tend to drive the ice off the American shore and westerly winds off the Siberian side. With these few exceptions little can be said of ice conditions.

"In clear weather the ice blink indicates the presence of ice, and it may be seen a great distance, but in thick, foggy weather approach to the pack must be made with great caution. Its proximity is usually indicated by the slack, and when this once begins to be seen about the vessel it may be judged that a large body is not far distant. As the pack is neared one sees only ice as far as the eye can reach. It rises from 10 to 25 feet above the water. It is a well-known fact that the depth of water and the surrounding features of this ocean render the formation of large icebergs an impossibility.

"When a pack is reached it usually becomes necessary to track along its edge to find a lead. Whoever is piloting the ship takes his place at the masthead, and with glass in hand seeks for a favorable opening. Oftentimes days are spent working up and down along the ice without clear water presenting itself, and when it does extreme caution must be used in entering the lead. It is here that the judgment and experience of the ice pilot becomes a necessity. The weather, currents, appearance of the ice, probable winds, and a dozen other things that would never enter the mind of a novice, are to be taken into consideration before the vessel's head is turned into the pack. Once it is determined to enter the lead vigilance must be doubled and every faculty kept on the alert. The vessel is coned from the masthead, and, while directing how the helm must be put to keep clear of immediate danger, the pilot must be looking ahead for the clearest water, and watching ice, sea, and sky for change of currents and winds. If any signs of the closing-in of the lead are presented the vessel must be gotten out as soon as possible, for, if shut in and she escapes being crushed, she will go to the

northward in the drifting pack from 1 to 2 knots per hour, and it will become necessary to abandon her. If the lead followed up is between the ground ice and the pack and the wind comes on shore, a safe place can sometimes be found behind the ground ice. A vessel may be made fast to this ice with grapnels, or anchored to leeward of it, and lay with comparative safety. If anchored in a current, however, with drifting ice about her, the scope of chain must be short, and everything kept in readiness for getting under way at a moment's notice. If anchored in shoal water, it is desirable to get in the ice as far as possible to avoid the swell; but if the water is deep the ice should be avoided. Generally the presence of the ice tends to kill the swell, and it will be found much smoother inside the ice than out.

"The bowhead whale keeps as far to the northward as he can find spouting holes, and to take him the whalers are obliged to keep as close to the pack as possible. Usually they track along the Asiatic side in Bering Sea and Strait, and, as they reach the Arctic, cross over and work up the American shore to the northward and eastward. In Bering Sea there is very little danger in entering the ice, as it is almost sure to open and offer a chance to escape before reaching the Arctic. With a knowledge of this fact, whalers sometimes enter the ice to the southward of the strait and endeavor to work through it if they have reason to believe, from the sudden disappearance of the whale, that there is clear water to the northward. In the Arctic, however, the pack is carefully avoided, and it is only when conditions are most favorable that attempts are made to follow up the leads. Point Barrow is approached with the greatest caution, as it is one of the most dangerous places in the Arctic. As has already been mentioned, by far the major portion of the vessels lost in the Arctic are wrecked in its vicinity."

Ice.—Bering Strait is free of ice by the first week in July and sometimes earlier, but clear water does not extend very far northward, and it is seldom possible for vessels not fitted to encounter ice to reach Point Hope before July 10–15. Kotzebue Sound is usually open by July 15, at times a few days earlier, but it has been known to remain closed until the last of July. The running ice from Kotzebue Sound is encountered at Point Hope some time after the pack has moved northward. By July 15 the main pack has moved north of Cape Lisburne.

Thus far the movement of the ice does not appear to depend to such a great extent on the winds, it is reasonably certain each year, and dates can be depended upon within a small limit of time; but north of Cape Lisburne the movement is generally slow, uncertain, varying greatly in point of time in different years, and seems to depend almost wholly on the winds for its further movement. Prevailing northeasterly winds move it away from the shore rapidly and early, while southwesterly or westerly winds hold it against the shore and make a late season.

From Icy Cape north no specific time can be set for the opening of navigation. Its variations are from July 12 to the latter part of August, though an average date for the whaling vessels to reach Point Barrow is about August 1. Between these points in the early part of the season the ice is always dangerously near the shore, and southwesterly or westerly winds will bring it in. Later, the southern point of the pack is just off Seahorse Islands and generally remains there the rest of the season. From the Seahorse Islands to Point Barrow the pack is seldom far offshore, and from the latter point can almost always be seen. During the open season it is always liable to come in on these two points with a westerly wind.

Beyond Icy Cape there is always danger to vessels, and strangers should be cautious and careful in going there. In the lead of open water between the pack and the shore the current is swift and nearly always carries drift ice, and vessels rarely reach Point Barrow at any time without encountering some ice. The ice can not be forced, and vessels should not venture into small leads between the pack and shore ice. With a southwesterly or westerly wind, which brings the ice in, vessels seek protection east of Point Barrow when it is open, in Peard Bay close in as possible, and under the lee of heavy ground ice, which acts as a breakwater against the smaller cakes. In anchoring where there is drifting ice, vessels should use a short scope and be ready to get under way immediately. A comparatively small cake will sometimes cause the loss of an anchor and chain. In the vicinity of Point Barrow sailing vessels

should not go offshore in water too deep to anchor, as in light winds or calms the current is likely to take them into the pack. Navigation east of Point Barrow is such that it should only be attempted by those having experience.

As a rule, the pack does not come down on Point Barrow before the latter part of September, but in 1897 it came down the first of September, and, in general, except for whaling vessels, whose officers are men of long experience in judging the ice, weather, etc., September 1 is as late a date as vessels should remain in that vicinity. About this time, or a little later, young ice begins to make in the lagoons, along the shore, and around the old ice, though it is not likely to form in the open sea until the last of the month. The young ice makes stronger and spreads over the open sea with the advancing season. It is dangerous to vessels, and will very quickly cut through one not sheathed to withstand it. Ordinary vessels should be out of Kotzebue Sound by September 15 to 20, and out of the Arctic by October 1. The whaling vessels make it a rule to be ready to leave there about October 10, and though there may be times when they stay later, these are exceptions.

At times there is a body of ice, which holds on the Siberian shore through the summer, that moves down past East Cape into the western side of Bering Strait, sometimes as early as the latter part of August, and makes that side of the strait difficult of navigation late in the season.

Weather.—In summer the weather is usually light, with much fog and rain. The winds are variable, though mostly easterly and southerly. There are seldom gales in summer, but occasionally, sometimes with intervals of years, there come southwesterly gales, short-lived but very severe and disastrous, as there is little protection from winds in that quarter. In the vicinity of the ice the weather is nearly always light and foggy. Later in the season it grows more boisterous, gales are frequent and more generally from northward, and as the weather grows colder there is considerable snow.

Currents.—From Bering Strait to Point Barrow there is a general current setting northward alongshore (stronger inshore), which, when not affected by winds or stopped by the ice, has a velocity of not less than 1 mile at any part of it. The current from the strait turns northeastward and is joined north of Cape Krusenstern by that from Kotzebue Sound. From Eschscholtz Bay a northerly current sets alongshore on the eastern side of Kotzebue Sound, having a velocity of $\frac{1}{2}$ to 1 mile at Cape Blossom. It continues past Cape Krusenstern, where it is increased by the flow from Hotham Inlet to a velocity of 1 to 2 miles, and northward of the cape joins the current from Bering Strait, where, in the latter part of July and August, its velocity is $1\frac{1}{2}$ to 2 miles. It continues with the same velocity around Point Hope, then with a reduced velocity to Cape Lisburne and across to a short distance south of Point Lay. After rounding Point Hope, and thence to Icy Cape, the current does not appear so strong, and, as a rule, is about 1 mile.

In the bight between Cape Lisburne and Cape Beaufort there is a tidal current, and, unless driven in by a westerly wind, the outside general current is not felt.

Northward of Point Lay, if the ice has not opened up from the shore, the current is stopped; but if the ice is open to Point Barrow the current continues along the shore and, because of the contracted space between the shore and the ice, increases in velocity to from 2 to 3 miles, and sometimes more, at Point Barrow.

This general current is more or less affected by the wind, and may be decreased or even stopped at times by northerly winds, but when the wind abates it starts again. When the wind is with the current its velocity is increased. Well offshore the currents are variable and not so strong, and depend to a great extent on the winds. There is, however, a general set northward.

Cape Prince of Wales is a peak, 2,300 feet high, comparatively regular in outline; on the south and southwest sides the slope of the mountain comes down to the sea. The face of the cape is a low sand beach, which extends northward 3 to 4 miles from the base of the mountain, and then trends northeastward toward Shishmaref Inlet. On this sand beach, close to

the mountain, is the native village of **Kingegan** (Wales post office), the largest on the northern coast.

On approaching the cape from southwestward, nothing less than 20 fathoms can be had at a distance of $\frac{3}{4}$ mile from the highland at its southwestern extremity. From this point the 20-fathom line runs nearly northwest, gradually increasing its distance from shore until 5 miles northward, where it is 3 miles offshore. The 3-fathom line, commencing very close to the southwest point, increases, almost at once, its distance from the shore to 1 mile, continuing at that distance until the cape makes northeastward, where it joins, presumably, Cape Prince of Wales Shoal.

Cape Prince of Wales Shoal seems to be a ridge of sand, which extends about 8° true (*N. by W. mag.*) from the western extremity of the cape to a distance of about 25 miles. The depth of water on the shoal is not definitely known, but numerous cases are reported of whaling vessels having struck on it at distances supposed to be 10 or 15 miles from the cape. The western face of the shoal is very steep, the depth decreasing rapidly from 20 fathoms. It is recommended that vessels give this shoal a wide berth, and not haul eastward when coming from southward until at a distance of 25 to 30 miles from the cape. Vessels bound southward through the strait should be careful not to fall too far eastward and be caught between the shoal and the northern shore, especially sailing vessels with northerly or northeasterly winds.

Vessels making an **anchorage** off the native village of Kingegan at Cape Prince of Wales should approach it only from southwestward. The soundings decrease rapidly from 13 fathoms, and anchorage should not be made in less than 7 fathoms. During the open season the current sweeps by the cape northward with a velocity of 2 to 3 miles, and care should be taken in making an anchorage here not to be swept by this current upon the shoal.

Fairway Rock is a high, square-headed, steep-sided rock. The bottom is steep-to on all sides, and there are no outlying dangers.

Big and Little Diomed Islands rise abruptly from the sea, with nearly perpendicular sides; they are steep-to, and there are no beaches. The tops of the islands are a sort of broken table-land. The larger island is 1,759 feet high, the smaller somewhat lower. In their vicinity the water is deep with generally rocky bottom, and the anchorage is poor. There are some rocks above water close to shore on the west side of the larger one. The native village on the larger island is on the southwest side, off which vessels can anchor in 14 fathoms, sandy bottom. The channel between the islands is about 2 miles wide. It is not generally used, but whaling vessels have passed through, carrying 20 fathoms of water, favoring the side of the channel next the larger island. There is a native village on a rocky slope on the smaller island facing this channel, off which a reef of rocks and sand is said to extend a short distance into the channel.

East Cape is a bold, rugged headland, about 2,500 feet high, steep on all sides, and with deep water quite close-to. It has low, marshy land back of it, and when seen at a distance appears as an island. There are no dangers off the land, and except at the anchorages the water is deep with rocky bottom. There is good anchorage (in 8 fathoms) with good shelter from offshore winds, on both the north and south sides of the cape, where the low land back of it begins. There is also an anchorage (in 10 fathoms, muddy bottom) off the native village on the face of the cape.

From Cape Prince of Wales to Shishmaref Inlet the coast is a low sand beach, with lagoons and marshes back of it. On a clear day the mountains in the interior can be seen, the Ears and Potato Mountain (Cone Hill) being distinguishable.

Shishmaref Inlet, a large inlet extending into the land, has been explored by prospectors. Across its mouth is a low sand island, with shallow openings at each end. Shoal water extends off the mouth of the inlet several miles. It is reported that small craft can enter the inlet, and that there is shelter for such behind the island at the entrance.

From Shishmaref Inlet to Cape Espenberg the coast is higher than that westward of the inlet, and is a line of low bluffs and small sand dunes, terminating at Cape Espenberg in a very low spit, which is made out with difficulty. A number of small native settlements are scattered along this coast from Cape Prince of Wales to Cape Espenberg.

KOTZEBUE SOUND

is about 30 miles wide at its entrance between Cape Espenberg and Cape Krusenstern, 22 miles from Cape Espenberg to the shoal water off the mouth of Hotham Inlet, and extends about 30 miles south of Cape Espenberg. Except for the shoal off the mouth of Hotham Inlet, the soundings throughout the sound are very uniform, varying from 7 to 9 fathoms. From Cape Espenberg the west shore of the sound is shallow some distance from the land, and vessels should approach it with care. The land on this side of the sound is generally low. There is a small but conspicuous hill about halfway between the cape and the southern shore. On the south side of the sound the land is higher, more rocky, and of a bolder character than the west shore. Under water, also, it is bold, and has soundings of 4 and 5 fathoms quite close to the promontories.

Chamisso Island, at the entrance to Eschscholtz Bay, is a small, rounded island with a grassy hill 231 feet high. Its shores are rocky, except its northeast end, which is a low sand spit. Along its north and east sides shoals extend $\frac{1}{4}$ to $\frac{1}{2}$ mile offshore.

Puffin Islet, west of Chamisso Island, is rocky, with two conspicuous rocks southward of it. Between the island and rocks and Chamisso Island the water is shoal and rocky. The water on the north and west sides of Puffin Islet is bold.

Chamisso Anchorage, between Chamisso Island and Choris Peninsula, is the only place on the Arctic coast of Alaska that can be called a harbor. By shifting anchorage $\frac{1}{2}$ mile good shelter can be found from all winds. Off Choris Peninsula shoals extend toward Chamisso Island fully 1 mile. The deepest water is close to Puffin Islet. In approaching the anchorage give Point Garnet, the southwest extremity of Choris Peninsula, a berth of 1 mile, and stand down well toward Puffin Islet before hauling in. Anchor with Puffin Islet bearing 203° true (*S. mag.*) at a distance not greater than $\frac{3}{4}$ mile, in 8 fathoms, muddy bottom.

Early in the season, fresh water can be obtained on Chamisso Island and on the east side of Choris Peninsula.

Tides.—The mean rise and fall at Chamisso Island is 4.0 feet.

Kiwalik River empties on the southern shore about 8 miles southward of Chamisso Island. It is reported that with local knowledge a depth of 12 feet at high water can be taken into the river to an anchorage behind the spit at the mouth. **Kiwalik** is a post office on the spit at the mouth of Kiwalik River.

Deering is a post office on the south side of Kotzebue Sound at the mouth of Inmachuk River, about 22 miles westward of Kiwalik.

Eschscholtz Bay, east of Chamisso Island and Choris Peninsula, is generally shoal. The soundings decrease gradually from Chamisso Anchorage to $2\frac{1}{2}$ fathoms at 2 miles off the point which lies 4 miles west of Elephant Point. East of this point the shoaling continues, and this part of the bay is only navigable for small boats. The shore at the head of the bay is difficult of access on account of long, muddy flats, which, at low water are bare in some places $\frac{1}{4}$ mile from the beach. It is probable that the whole bay is gradually filling up, and vessels going east of Chamisso Anchorage should proceed with caution. Buckland River, a large but shallow river, empties into the head of the bay. There are few natives in its vicinity.

Choris Peninsula, forming the western side of Eschscholtz Bay, has two hills, about 300 feet high, separated by a low, sandy neck. Northward of Choris Peninsula the land is low for some distance, and then rises into low bluffs which continue to Hotham Inlet. These bluffs are composed of ice and frozen mud, which is gradually melting and sliding down, making deep furrows all along their face.

Cape Blossom is a distinctly marked point in this line of bluffs, which are highest at the cape and slope to either side.

The bottom of this side of the sound is very even southward of Cape Blossom at a distance of about 5 miles from the land; but northward of the cape a shoal, with very little water on it, extends 8 to 10 miles off the land from the mouth of Hotham Inlet, and south to within 2 miles of the latitude of Cape Blossom. This shoal is very dangerous, as the soundings give short

warning of its proximity, the distance from the shore can not be judged under ordinary conditions, and there are no good landmarks.

The general **anchorage** in this vicinity is off Cape Blossom, as it is the nearest point from which communication can be had with Hotham Inlet. In approaching the cape, it should not be brought to bear eastward of 90° true (*ENE.* mag.) until in the vicinity of the anchorage. Anchor in 5 fathoms with the cape bearing between 90° true (*ENE.* mag.) and 102° true (*E. by N.* mag.) distant 3 miles. This anchorage is protected from northerly and easterly winds. There is generally a current, strongest in the early part of the season, with a velocity of $\frac{1}{2}$ to 1 mile, setting northwestward.

The coast from Cape Blossom to the mouth of Hotham Inlet is the place of rendezvous for the natives of the surrounding country for the purpose of fishing and trading. The coast natives from Cape Prince of Wales, including the Diomedes and King Island, to Point Hope assemble here about the last of July to meet those who come down the large rivers from the interior.

HOTHAM INLET

is about 35 miles in length and 4 to 8 miles in width. Its general trend is southeast; its water is little influenced by tides, but a prolonged southeast wind causes a low stage. The entrance is obstructed by vast mud flats and sand bars, some of which are bare at low water. There is a shifting channel, which is difficult to trace, running close along the shore from Cape Blossom north to the inlet, through which 4 to 5 feet can be carried. This channel could not be found in 1898. A channel with a depth of 8 feet on the bar at high water was used in 1898, but it is difficult to find without a pilot. The entrance to this channel was about 10 miles from the Cape Blossom shore and well northward of the cape. Winds from southward and westward raise the water on the bar and from northward and eastward lower it. In the inlet proper the channel in 1884 had a depth of 3 to 7 fathoms for a distance of 20 miles. There are three large rivers emptying into the inlet. No landing can be made at many places in the inlet on account of extensive mud flats.

The **Noatak River**, joining it at the north, has numerous rapids, and is not navigable for any distance for boats larger than native canoes. The natives portage from the headwaters of this river to the Chipp River, and thus to the Arctic Ocean east of Point Barrow.

The **Kowak River** empties at the east side of the inlet by many mouths, off which shoals with 2 to 4 feet extend far out into the inlet. In crossing the bar, which is indicated by drift lodged on the shoals, it is difficult to find a channel, the one generally used being known as the "Middle Mouth." The delta from the inlet is about 45 miles long and very difficult to navigate, but when fairly between the banks of the river there is comparatively deep water. In 1898 a large number of prospectors were attracted to the region of Hotham Inlet. Two stern-wheel steamers were used in transporting their supplies up the Kowak River, and it is said that these steamers ascended the river 200 miles. The current in the river was found very strong, running at some points with a velocity of 5 or 6 miles an hour. The current is dangerous for small boats; eight men lost their lives in 1898 while boating their provisions up the river. The natives portage from the headwaters of the Kowak River to the Koyukuk River, a branch of the Yukon.

Selawik Lake is the prolongation of the head of Hotham Inlet eastward; it is about 50 miles long and 20 miles wide, and a depth of 2 fathoms can be taken around the lake by giving the shores a good berth. It has a large river, Selawik River, emptying into it at its head, the entrance of which is obstructed by a mud flat extending $\frac{3}{4}$ mile from the shore, through which a depth of 12 feet could be carried, in 1884, into the westernmost outlet of the river into the lake.

From Hotham Inlet to Cape Krusenstern the coast is a low beach. The shoal water from the mouth of the inlet extends nearly halfway to the cape; the edge of the shoal is steep, and should be approached carefully. From where the shoal joins the land to Cape Krusenstern there is good water close in, with regular soundings.

Cape Krusenstern.—Back of Cape Krusenstern there is a high, prominent range of mountains, which can be seen at a long distance. On nearer approach the mountains are

seen to fall away to the cape in a series of steps, and in shaping a course into the sound these cliffs, or steps, must not be mistaken for the cape, which is a low point extending about 3 miles westward of them. A shoal extends about 2 miles westward and northward off the point of the cape.

From *Cape Krusenstern* to *Cape Seppings* the coast is a low, shingly beach, back of which is a series of lagoons, which discharge their waters through small, shallow openings. The high land of *Cape Krusenstern* extends along this coast some distance inland, terminating in the *Mulgrave Hills*, about 30 miles northwestward. After passing *Mulgrave Hills* the land is an extensive plain until in the vicinity of *Cape Seppings*. Here the mountains approach close to the coast and slope down to the water. *Cape Seppings* and *Cape Thompson* are not distinct, and it is difficult to determine the points to which the names should be applied.

In the vicinity of *Cape Thompson*, for a distance of 6 miles, the mountains break off directly to the water in a series of abrupt cliffs about 500 feet high. The coast is generally straight, and there are no distinct promontories. What was probably named *Cape Thompson* is a rugged mountain face, about in the middle of this line of cliffs, having at its southern end a distinct series of strata in the form of an irregular semicircle. In the ravine south of this point there is a small stream, from which good water can easily be obtained. Directly off the watering place anchorage may be had in 5 fathoms, sandy bottom. At other points along the cliffs the bottom is generally rocky.

From *Cape Thompson* the mountains continue northward to *Cape Lisburne*, while the coast curves northwestward and westward to *Point Hope*.

Point Hope is the western extremity of a low tongue of land which projects almost 16 miles from the general line of the coast mountain range. It has a steep shingle beach, and its surface is broken by a number of lagoons. The largest of these, *Marryat Inlet*, has its entrance on the north side, close to where the coast trends northward, and a draft of 10 feet can be carried through the entrance. For a number of years some small schooners have been using this inlet as a place to winter. Those not familiar should sound out the channel before entering. In the first of the season, when the ice breaks in the inlet, there is a strong current running out and the moving ice is more or less dangerous. There is a large native village called *Tigara* on the end of *Point Hope*, and scattered on the south side, from the end of the point to *Cape Thompson*, are a number of whaling stations conducted by white men, which are maintained throughout the year.

In the bight just north of the high land of *Cape Thompson* the water is somewhat shoaler than farther west, though the soundings are regular. Seven miles east of *Point Hope* there is a 3-fathom shoal nearly 1 mile offshore. As the point is approached the water deepens, and toward its end 8 fathoms can be carried to within $\frac{1}{4}$ mile of the beach. The tip of the point is very bold, there being 13 fathoms a few ship's lengths from shore; but on rounding the point to the north side the soundings decrease rapidly to 5 fathoms $\frac{1}{2}$ mile from shore, and, in general, the water in the bight on the north side of the point is shoaler than on the south side. At the mouth of *Marryat Inlet* shoals extend off some distance.

There is a narrow shoal, with a depth of 4 fathoms at its southern end, which lies about $2\frac{1}{4}$ miles 314° true (*WNW. mag.*) from *Point Hope*. This shoal extends in a general 314° true (*WNW. mag.*) direction for a distance of 3 miles from the 4-fathom spot, and has depths of 5 to 7 fathoms over it.

From the mouth of *Marryat Inlet* to *Cape Lisburne* the mountains lie along the coast and terminate at the shore in rugged, rocky cliffs. There are a few ravines through the cliffs, having running streams, with beaches at the shore, where fresh water can be obtained.

Cape Lisburne is a bare, brown mountain, 850 feet high, forming a rugged headland that is distinctly marked by the number of pinnacles and scattered rocks near its summit. Its faces at the shore are very steep. At the cape the coast changes its direction abruptly eastward. There are no outlying rocks, but there is a ridge extending 5 miles northeastward from the cape, on which 5 fathoms can be found at a distance of 2 to 3 miles from the land. Off this cape the wind rushes down from the mountains in gusts of great violence and varying directions, and with offshore winds vessels should keep well off the land in passing.

From Cape Lisburne to Cape Sabine the land is lower and loses the rugged character of that southward of the former cape. The hills are rounded and rolling, regular in outline, and slope to the sea. Toward Cape Sabine the land becomes a series of ridges and valleys running inland; both terminate at the coast in bluffs.

Cape Sabine is the end of one of these ridges, and projects but slightly from the general line of coast.

Coal.—Veins of coal are found from Cape Thompson to Cape Beaufort. In the face of the bluffs at Cape Sabine some veins, varying in thickness from 1 to 4 feet, have been worked by whaling vessels. The veins show plainly along the top of the bluffs directly at the shore. The use of the coal is limited, owing to its poor quality and the difficulties in obtaining it, and it is not recommended to depend upon it except in case of necessity.

From Cape Sabine to **Cape Beaufort** the land continues of a rolling character until nearing the latter cape, which is a dark mountain coming down directly to the coast. There is no break in the coast at the cape, and it probably received its name as such because seen at a distance. This is the most northern extension of high land on the coast of Alaska. The mountains at this point trend inland and the coast continues low.

The bight from Cape Lisburne to Cape Beaufort is comparatively shallow, but the bottom is regular and anchorage may be had anywhere alongshore from 1 to 2 miles from land. Directly off Cape Beaufort the water is shoaler than elsewhere between it and Cape Lisburne. There are numerous valleys along this part of the coast, nearly all of which have streams of good water. North of Cape Beaufort it is almost impossible to obtain fresh water on the coast.

About 10 miles north of Cape Beaufort is the southern end of a large **lagoon**, which stretches along the coast without a break to within a few miles of Wainwright Inlet. Separating this lagoon from the ocean is a narrow strip of sand beach, elevated but a few feet above the water, with several small, shallow openings through it south of Icy Cape, and two considerable openings north of that cape. The land on the inside of the lagoon is generally low, but in coasting along, some small bluffs, with low, rolling land back of them, can be seen in places. South of Icy Cape the lagoon has three large rivers emptying into it, and its whole extent is filled with flats and bars that make it scarcely navigable even for native canoes. North of Icy Cape the water in the lagoon is deeper. Through an opening about 10 to 12 miles from the cape 8 feet of water can be safely carried, with 2 to 3 fathoms inside. The channel is close to the sand spit on the south side of the entrance.

Another opening, 10 to 12 miles farther north, is somewhat shallower.

Point Lay and **Icy Cape** are merely bends in the sand spit forming the coast. Both places can be distinguished by some hummocks on the beach. A wooden beacon, 20 feet high, was erected on Icy Cape to mark the beginning of Blossom Shoals.

From Cape Beaufort to Icy Cape the bottom is regular, and the shore can be approached closer than in that part of the bight west of the former cape. When coasting, it should be remembered that off the openings into the lagoon the water is shoaler than on either side.

Blossom Shoals extend 6 to 8 miles off Icy Cape, and are a number of ridges parallel with the coast. These shoals are greater in extent than shown on any chart, and, from the grounding of vessels and observation, appear to be spreading. In approaching the shoals the bottom is lumpy and the soundings irregular. Of late years, on account of frequent grounding in unexpected places about the edge of the shoals, all the whaling vessels give them a wide berth; and it is recommended that vessels rounding Icy Cape should keep outside of 12 fathoms.

Wainwright Inlet, about 40 miles from Icy Cape, is a moderate-sized lagoon, and has a river emptying at its head. Its entrance, between Point Marsh and Point Collie, is a narrow, difficult channel, through which 8 to 10 feet can be carried. Inside the water is deeper. Off the mouth of the inlet the water is shoal fully 1 mile from land.

The coast from Point Collie to Point Belcher is a continuous line of mud cliffs until within a few miles of the latter point.

At **Point Belcher** the coast again becomes a shingle beach, with lagoons inside, and back of it low, rolling hills, which are higher than any other land that can be seen north of Cape Beaufort. North of the point the coast continues in a very low sand beach to Seahorse Islands.

Seahorse Islands and **Point Franklin** are the highest points of a continuous sand bank which extends from a point 8 miles north of Point Belcher to Point Franklin, thence turning abruptly east to the mainland at Peard Bay incloses a large lagoon. The first two islands from Point Belcher are higher than the rest of the bank, and their position seems to be permanent. The openings between the islands are, as a rule, very shallow and continually changing. Former openings are now closed, and openings now occur in the positions of former banks. Point Franklin is a very small sand island, with several hummocks on it. It is so small and far removed from the other islands that it is not easily made out. The greatest changes in the bank occur in that part of it between Point Franklin and Peard Bay, of which what is above water is merely a narrow strip of sand.

In the vicinity of Seahorse Islands the water is shoal, especially off the openings and Point Franklin. Off Point Franklin a shoal makes out several miles northward and northeastward, and vessels rounding the point should give it a berth of 4 to 5 miles.

Peard Bay, eastward of Point Franklin, is a deep bight, which is often used by whalers in heavy southerly and southwest winds, and for protection from ice when it sets toward the shore. The bottom of the bay is regular, and the soundings decrease gradually to the shore. The water is deeper along the mainland than on the south side along the sand spit making out to Point Franklin.

The coast from Peard Bay to Cape Smyth is a line of mud cliffs 25 to 70 feet high, being highest at what is called Skull Cliff. From this point they become gradually lower to Cape Smyth, where they end. The coast curves regularly northward, and there are no projecting points. The cliffs are broken by numerous small rivers. There are beaches at the mouths of the rivers, but little or none along the face of the cliffs.

Cape Smyth is not a projecting point, and can not be distinguished as a cape. There is a large native village at the end of the mud cliffs at this point. The United States signal station and refuge station, formerly here, are not now maintained, but there is a whaling station conducted by white men.

From Cape Smyth to Elson Bay the coast is low with a grassy plain back of it; but from the head of Elson Bay to Point Barrow the coast is a narrow sand spit.

Offshore from Refuge Inlet to the head of Elson Bay the water is deep, and soundings of 15 fathoms are found about 2 miles from the land. The water then shoals evenly to 7 fathoms at about 1 mile from shore. The depths then lessen rapidly to $2\frac{1}{2}$ to 3 fathoms about $\frac{3}{4}$ mile offshore, where there is a slight ridge shoved up by the ice, and which in the early part of the season is always marked by heavy ground ice. Inside and close to this ridge the water deepens again to 3 to 4 fathoms, and vessels seek this inside passage for protection from the ice when necessary. The ridge ends in a $2\frac{1}{2}$ -fathom shoal about $1\frac{1}{2}$ miles offshore where the high land ends and the sand spit begins at the head of Elson Bay. From this point to Point Barrow, depths of $3\frac{1}{2}$ to 4 fathoms can be carried very close up to the sand spit, and there is apparently no ridge in the bottom as in that southward.

At **Point Barrow**, latitude $71^{\circ} 23' 31''$ N., longitude $156^{\circ} 21' 30''$ W., the most northern point of Alaska, the sand spit forming the coast turns abruptly eastward. There is a native village on the end of the point. Directly off the point the water is fairly bold, and 3 fathoms can be carried to within $\frac{1}{4}$ mile of the shore. Farther offshore the deepest water of this part of the Arctic Ocean is found. On rounding the point eastward the water becomes shoal, and the coast can seldom be approached anywhere closer than 2 miles. About 2 miles east of Point Barrow is **Moore Channel**, the entrance to Elson Bay, where H. M. S. *Plover* wintered in 1852-53-54. A shoal with a least depth of 2 fathoms makes off from the point on the east side of the channel, and extends westward, from $\frac{1}{2}$ to $\frac{3}{4}$ mile off the sand spit, and ends nearly opposite the native village on Point Barrow. Inside the shoal there is a channel leading to Moore Channel, with nothing less than 3 fathoms, and deeper water in Moore Channel. This channel is often used as an anchorage for protection from the ice, as heavy ice grounds on the outer shoal.

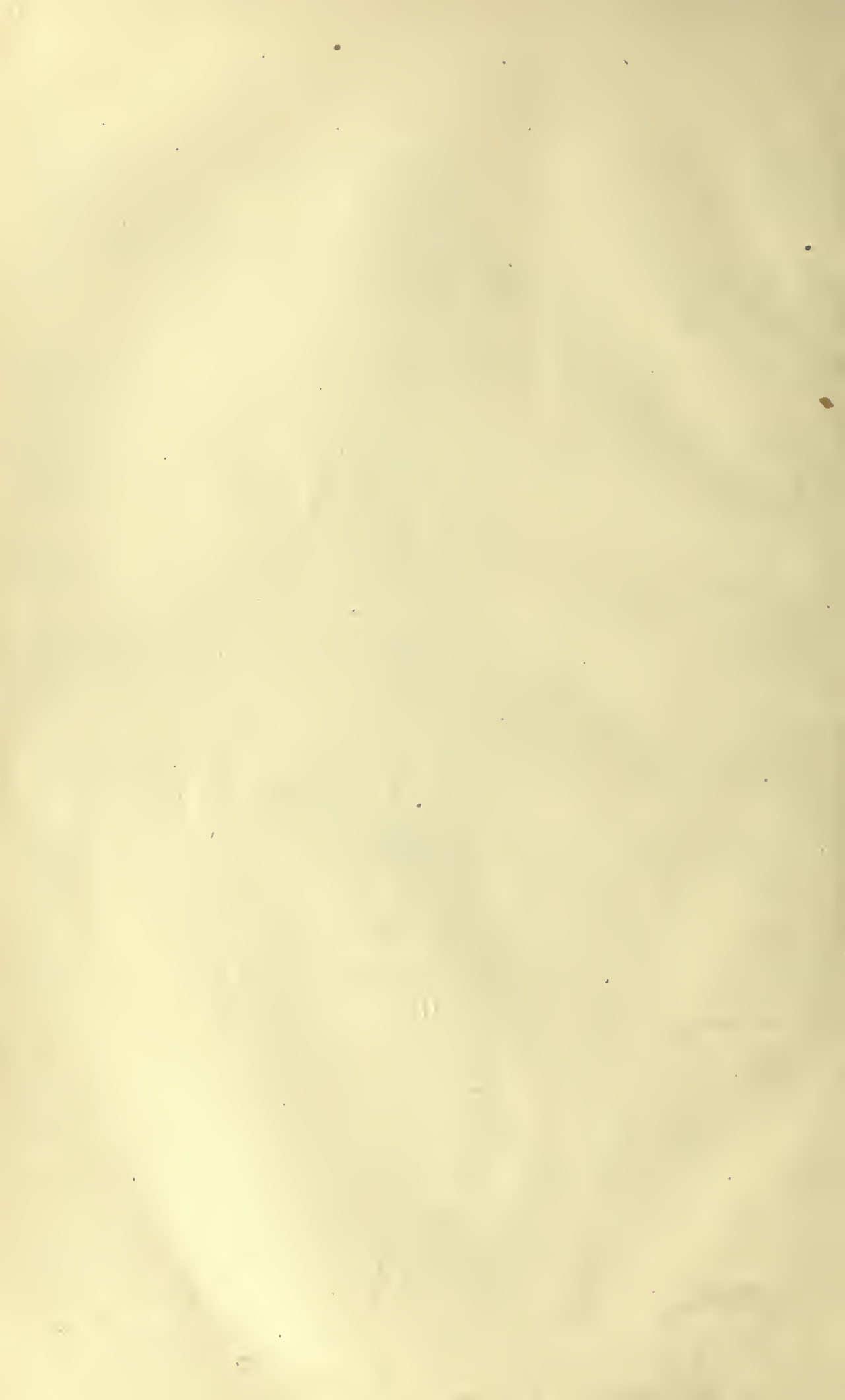
Tides.—The mean rise and fall at Point Barrow is 0.4 foot.

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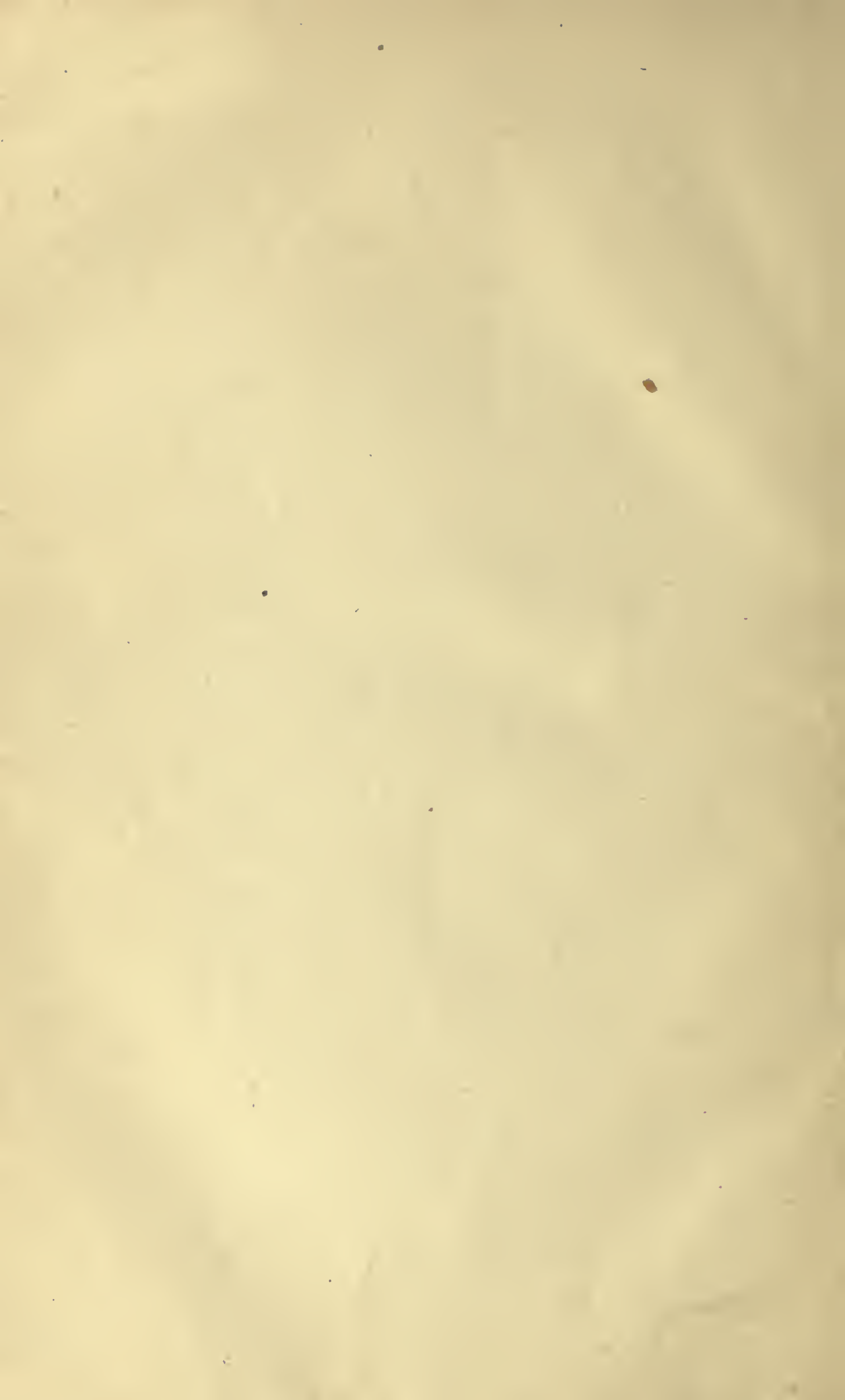
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